

JOURNAL OF THE
BATH & WEST & SOUTHERN
COUNTIES SOCIETY

FIFTH SERIES.

VOL. XIII.

1918 - 1919

SUTTON'S FARMERS' YEAR-BOOK FOR 1919

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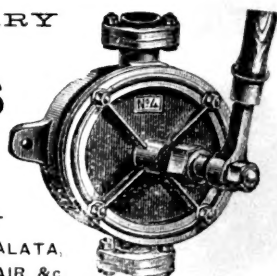
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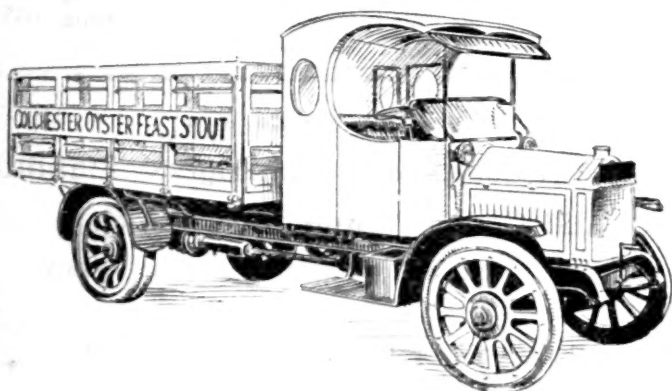
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FOR THE
ENCOURAGEMENT OF
AGRICULTURE, ARTS, MANUFACTURES AND COMMERCE.

ESTABLISHED 1777.

FIFTH SERIES.

VOL. XIII.

1918-1919.

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*Journal communications should be addressed to the Editor,
3, Pierrepont Street, Bath.*

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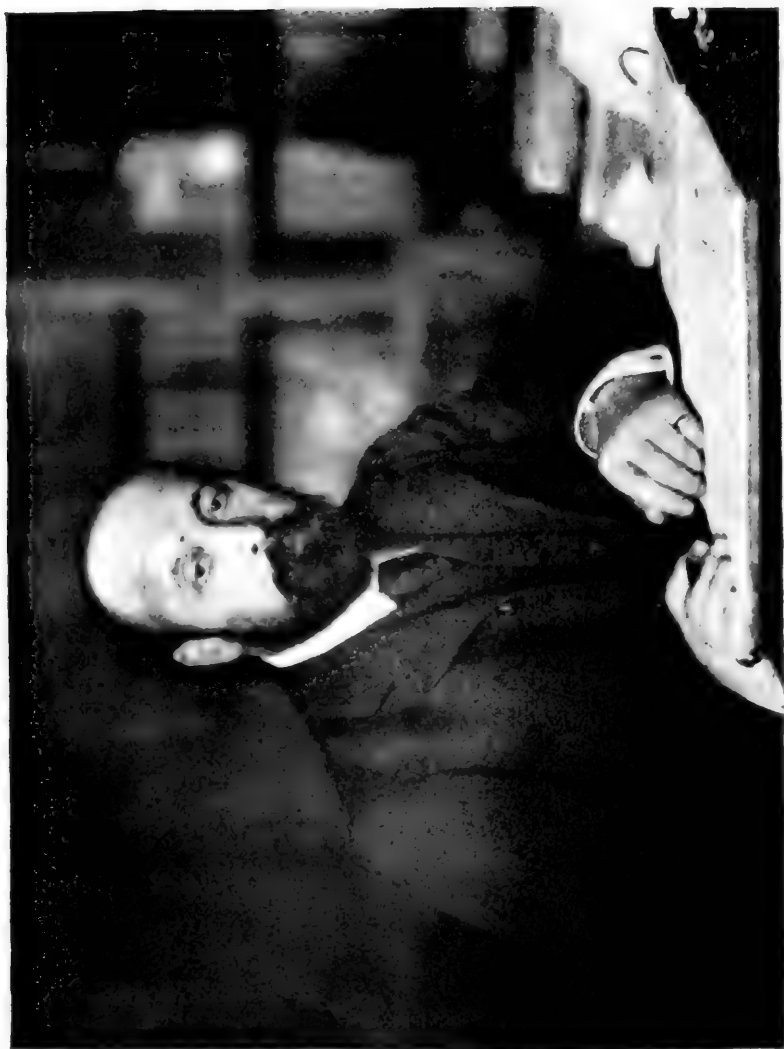
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THE LATE SIR C. T. D. ACLAND, BART.

JOURNAL

OF THE

BATH AND WEST AND SOUTHERN COUNTIES SOCIETY.

Original Articles and Reports.

In Memoriam.

I.—SIR C. T. D. ACLAND, BART.

By Thos. F. Plowman, Secretary and Editor.

As the last pages of this volume were passing through the printer's hands, there came the news, its sadness intensified by its suddenness, that Death had claimed one who for long had been a leading spirit in all concerning the issue of the Society's Journal.

Although Sir Thomas had been in failing health for some time past, no immediate danger was apprehended until within a day or two of his death when bronchitis supervened upon an ordinary cold. Lacking sufficient strength to resist the attack, life almost imperceptibly ebbed away, till, on the morning of February 18th, "God's finger touched him and he slept." Up to a week or two previously, he had been, as Chairman of the Committee, in correspondence with me upon Journal matters and also with respect to certain pending changes in the Society's *personnel*. He was so interested in the last-named subject that he held out a hope of coming to Bath to discuss it.

Sir Thomas, who, on personal grounds, elected to be known by his second Christian name rather than by his first of Charles, followed a family tradition in associating himself with the Bath and West Society, inasmuch as his great-grandfather joined it in 1786—only nine years after its establishment—and his example was followed by the two successors to the title; so that for nearly a century and a half the honoured name has always been found on the Society's

roll. There is a further lengthening of the chain linking up the present with the past, the heir to the title—the Right Hon. A. H. D. Acland being a Life Member of the Society, while the late Baronet's nephew, the Right Hon. F. D. Acland, M.P., who succeeds to the Devonshire estates, has been recently elected upon the Society's governing body.

The late Sir Thomas, who succeeded to the title and estates in 1898, was elected a member of the Society in 1872 and a member of the Council in 1873. Soon giving proof that he was ready and willing to be a practical worker, full advantage was taken of this, and in 1874 and two succeeding years, he was appointed one of the Stewards of the Show Yard. In 1877 he exchanged this office for that of a Stewardship of Gates, acting as such for the following nine years. This was by no means a sinecure-post, as it meant keeping watch and ward over the show-yard entrances and exits and the granting, or withholding, of free admission passes to exhibitors and others; a somewhat delicate and thankless duty now discharged by the Secretary's office. While serving the Society in this way, Mr. Acland was also paying tribute to the State as the Parliamentary representative, first, of East Cornwall and afterwards of the North-East Division of the same county, whilst his co-steward of Gates, Col. E. H. Llewellyn, sat for North Somerset; thus the many who preferred their claims for admission-privileges had the satisfaction of knowing that they were adjudicated upon by two of the kingdom's law-makers.

The zeal and efficiency which characterised the doing of whatever Mr. Acland put his hand to, resulted in his being placed upon the Dairy, Journal, Experiments, Arts and Implement Regulations Committees, and later on he was elected to the Chairmanship of the three first-named Committees. He was also, on the nomination of the Society's Council, appointed one of the Society's representatives on the Governing Body of the National Fruit and Cider Institute.

One of the last matters which had lately engaged his attention was the great dearth of skilled thatchers and, so recently as January last, the Council had before them for consideration an offer by Sir Thomas of a prize of £10 for lads under 18 who could thatch a rick; his desire being that such a competition should be carried out under the auspices of the Society.

In recognition of his many services, Mr. Acland, as he was then, at the Annual General Meeting of Members in 1894, was elected a Vice-President of the Society, and ten years afterwards was appointed one of its three Trustees.

Sir Thomas was much opposed to the offering of money-prizes for Stock at agricultural shows, his view being that the honour and glory of winning, coupled with its value as an advertisement, and with the addition of a medal as a memento, should be all-sufficient to satisfy exhibitors. With indomitable perseverance, he endeavoured to convert the Society's Council to his views, but it was one of the rare occasions when his colleagues failed to follow his reasoning. The exhibitors, too, manifested a distinct preference for hard cash. The experiment was tentatively tried of allowing an exhibitor to have a medal if he preferred it, but the money prizes held the field. He equally objected to the giving of premiums for implements after only short show-yard trials, rightly contending that a more lengthened and exhaustive test of an implement's capabilities, under ordinary working conditions and fair wear and tear, was necessary in order to satisfactorily establish its claims. The large majority of the Council were in agreement with this and affirmed the principle it represented.

Before the Board of Agriculture and County Councils came into being, little help was afforded to the most important of our industries beyond that rendered by agricultural associations. This induced the Society's Council to set on foot an important scheme to provide for systematised investigations and practical demonstrations in connection with the various departments of husbandry and for establishing experiment stations and educational centres for the testing and promulgating of improved methods in relation, especially, to dairying. Mr. Acland was one of the most active supporters of this new departure and rendered essential aid in bringing it to a successful issue. During the years in which the scheme was in operation, it had an important bearing upon agricultural education, as its subsequent recognition by the State testified. It was only relinquished when the establishment of the Board of Agriculture and other public bodies, either State-aided or Rate-aided, rendered the Society's assistance in the directions indicated superfluous.

But valuable as was the help the late Baronet rendered in the various departments mentioned, he established, I think, his best claim to the Society's gratitude by his work as Chairman of the Journal Committee, in which office he succeeded his father in 1898. For the last few years, impaired health prevented his undergoing the fatigue of travelling to the Society's meetings and taking an active personal part in the general management of the Society. Hence, as he was much less in evidence than were other members of the governing body, tribute should be paid now to the Society's deep indebtedness to him for work of a character

that could not well be brought prominently under public notice. Although it was of the utmost importance to the Society, it was so quietly and unostentatiously performed as to be known only to the very few immediately concerned with it. The unsparing diligence with which he fulfilled the responsibility entrusted to him may be judged from the fact that he never omitted to carefully read the proof of every article and report that appeared in the Journal during the whole term of his Chairmanship, and to return it with such suggestions—and they were invariably worth having—as he thought the occasion called for. He was also a frequent contributor of articles to the Journal, every one of which was marked by a thorough acquaintance with the subject to which it referred. An editor's duties would be much lightened if other contributors had a similar capacity for the taking of pains and as much regard as he had for simple accuracy.

I have rarely met with anyone whose interests covered so wide a field, for agriculture, literature, science and art all came within the range of his knowledge and his sympathies. With a cultured literary taste and a thorough knowledge of the laws governing composition, he possessed also the critical faculty in a marked degree. Those who know how much room there is for difference of opinion regarding what constitutes that "well of pure English undefiled" from whose depths all engaged in literary expression desire to draw inspiration, will understand and appreciate how much is represented by the fact that, notwithstanding the possible difficulties attendant upon a dual control, there was never a break in the perfect harmony existing between the Chairman and the Editor during the whole twenty years in which we worked in conjunction, and my Associate Editor testifies to a corresponding experience. Remembering that, as Chairman, he was naturally the controlling power, this happy relationship testifies to the gentle and kindly spirit in which he exercised his prerogative.

No one could be more tolerant of the views of others, however much they differed from his own, or could exercise more conscientious care in arriving at a conclusion. It can truly be said of him that, in relation to all mundane matters, he was as much a man of peace as a man of letters, always anxious to find a *modus vivendi* in the solving of life's problems, provided that it involved no sacrifice of the main principle.

The fact that the Journal comes directly under the notice of Council but once a year, when the issue of a new volume is reported, may not unnaturally lead to the supposition that the Chairman's position with regard to it is very much of a sinecure, and I gladly take this

opportunity, speaking from personal knowledge, of testifying that it has never been this in the case of either of the two Chairmen under whom I have served.

Space will not permit of even a brief epitome of the various public offices, outside the Bath and West Society, Sir Thomas held during his busy life or of the many movements, having for their aim the welfare of the community at large, with which he identified himself. All that was of good report appealed to him and the spirit in which he exercised his generosity strikingly testified to the broad-mindedness of his sympathies and the versatility of his aims. Two matters, however, with which the late Baronet's name will always be identified, although not directly connected with the Bath and West Society, come within the sphere of its interests. One was his successful efforts to improve the breed of Exmoor ponies and the other was his most generous and patriotic act in handing over to the care of the National Trust 5,000 acres of the finest part of Exmoor, so that it might for ever be preserved from injury and exploitation. It includes one of the most beautiful bits of wild country in the kingdom and Sir Thomas anxiously desired that it should ever be preserved in its natural state for the enjoyment of posterity. To its other attractions must be added its connection with many interesting incidents of county history, whilst the country it embraces will ever be endeared to the readers of "*Lorna Doone*."

In the presence of many members of the family and intimate friends and a large and representative gathering of the tenantry, his body was laid to rest in the soil of his native county at Columb John, near the ancestral home of Killerton, when a floral tribute "in affectionate remembrance from his friends and colleagues on the Bath and West Society's Council," testified, as did many other similar offerings, to the regard in which the departed was held by those who from personal experience knew and appreciated his worth. A special memorial service was also held at Exeter Cathedral at which the Society was represented.

From the time of its inception, the Bath and West Society has been exceptionally fortunate in its voluntary workers. The vitality which has sustained it during its long life, and such success as it has achieved in the course marked out for it, must be set down mainly to these shapers and moulders of its policy, who created and perpetuated its standard of work and responsibility. Instances of exceptional devotion to the Society's interests serve to bring forcibly home, from time to time, the strength of its hold upon those most capable of serving it and the disinterested zeal and enthusiasm

it is able to evoke. There is a sorrowful reminder of this, and of the void which the loss of a single individual can create in its ranks, in the death of so staunch a friend to the Society and so good a worker as was the subject of this Memoir. Giving of his best ungrudgingly for pure love of the cause, he was the personification of that disinterested earnestness which in times of stress and strain has done so much to sustain Agriculture.

II.—AGRICULTURAL RECONSTRUCTION.

*By James Long, Author of "Making the Most of the Land,"
"The Coming Englishman," "Food and Fitness," etc.*

INTRODUCTORY.

It will, I believe, be generally accepted by those who are experienced in agricultural affairs, that nothing should stand in the way of our future security, so far as it depends upon our home food supply, unless it touches our national honour or our sense of justice between man and man. If one may judge from the opinions expressed in the report of the Selborne Committee, every acre of land capable of food production should be cropped, without regard to the rights, privileges, or sporting instincts of its owners. There are hundreds of thousands of acres awaiting reclamation, while millions of acres of hill, down, and mountain land which have not been cultivated in our time, would respond to manure, and other assistance, in such a manner as to double their grazing value. If in addition, we consider the statement of the Secretary of the Board of Agriculture that no less than 800,000 acres have been lost to the national farm since 1892, we shall be in a better position to estimate the vital need for that reconstruction upon which our future depends. If the old habit of "drift" is allowed to continue, I tremble for that future. New men, however, have arisen to deal with old habits and old acres, and, as I believe, with old laws which, as they stand, deprive the vigorous administrator of the power he needs to deal with those who hold up land required for reclamation.

Increased food production depends upon various factors, including the following—

1. The increase of our arable area for the production of corn, forage, and other stock foods, potatoes, carrots, parsnips, artichokes, and other vegetables for the table, and of sugar beet.

2. The cultivation of all waste lands and uplands which will respond to artificial manure.
3. The extension of small holdings and allotments and an increase in the size of the latter.
4. An increase in the number and quality of live stock for which the improved uplands will largely provide.
5. Minimum prices for corn.
6. The compulsion of landowners and farmers who are not already doing their duty by the land—as proposed by the Selborne Committee.
7. The establishment of open markets for the sale of farm produce in country towns.
8. The establishment of Farm Schools for the training of the sons of small farmers at nominal fees.
9. The reconstruction of village life.

INCREASE OF ARABLE LAND.

The increase of arable land means largely increased production. If we estimate the yield of our grass crop, on the basis of our hay crop, at seven tons per acre (although it has been placed at a lower figure) and assume on an equally reliable basis, that the forage crops—vetches, clover, and grasses, trifolium, rye, sainfoin, and lucerne—will produce from twelve to twenty-five tons of—in most cases—still richer food, we shall be better prepared to believe in the possibilities of arable farming, the more so as some of these plants last for years, with hardly any expense either for cultivation or manure. If we regard the four-course system as prevalent in farming, it follows that a holding growing 100 acres of corn instead of 80 acres, will not only produce an additional 20 acres of straw, itself a stock food of considerable value, but an additional 20 acres of forage and roots, unless potatoes and other vegetables are selected for cultivation instead. For my own part I strongly hope that there will be no increase in the turnip area—which showed a reduction in 1918—for this bulb containing only $6\frac{1}{2}$ to 8 per cent. of feeding material, gives the poorest return of any crop on the farm, its average being $12\frac{1}{2}$ tons to the acre. The turnip area is already too large, except upon those light or thin soils on which it is regarded as indispensable for their improvement, and for the feeding of sheep. On this point I suggest that every crop should show a profit for growing, but this the turnip never does on very numerous farms. The average yield is so small that it fails to cover the cost, and if this is the case what can be said of those counties which never reach 11 tons to the acre. Hunts, with

an average of 7·14 tons, Cambridge, with 9·68 tons, Sussex, with 10·42, and Rutland, with 10·38, are examples in point. In a moderate season like 1915 the yield fell below 10 tons in no less than eight counties, yet this crop, which in no county reaches an average of 18 tons to the acre, covered nearly a million acres of land in 1917, while much superior plants were ignored.

Let us, however, return to the increased production of stock food on the 20 acres of arable land which replace 20 acres of grass. Among the new crops the mangel might be selected where it is likely to yield favourably, although here, too, consideration is required. This plant will yield from the average of 19 tons up to 60 tons to the acre. Forty to fifty tons are not uncommon yields with good growers, and such I have met with in certain cases, although I find that no less than 13 counties average less than 17 tons to the acre. That better farming would alter this ridiculous figure I have not the least doubt, and the question is: How is this farming to be established among the less capable, less enterprising, and less educated men? My answer is simple enough. I believe through the War Agricultural Committees, consisting chiefly of farmers, and which have done most praiseworthy work, for no men are so well calculated to deal with a farm which is mismanaged, or with a tenant who wilfully fails in his duty.

If turnips and mangels are excluded from the additional arable land placed at the farmers' disposal by ploughing up grass, one portion should be devoted to potatoes and roots—such as carrots and parsnips—for the feeding of pigs, large numbers of which could be bred and fed at a cost of one-third the sum usually spent upon meal. The remainder could be used for green forage plants—such as clover and grasses, maize, trifolium, rye, vetches, and rape. The result would be that more stock could be fed, and fed cheaper, both in summer and winter.

It cannot be too clearly asserted that maize, and all the leguminous crops, whether annual or perennial, although some can be made into hay, can be successfully preserved in a silo for winter consumption, thus providing at much smaller cost a superior food to the turnip. Since the advent of the silo in East Anglia, some six or seven years ago, large numbers have been built, although, owing to the enhanced cost, which the war has occasioned, their construction has been checked. One of the pioneers in this enterprise, who grows maize for preservation for the winter feeding of his cows, publicly stated, to a large gathering of farmers who were invited to witness his work, that the turnip was the rock on which tenants were splitting. That they should prefer to grow 12½ tons of turnips

on land capable of producing 40 tons of maize which, weight for weight, is a much superior food, is a fact so incredible that he was justified in his remark. I speak not only as one who has grown both crops extensively, but as one of the Judges in the Silo Competition of the Royal Agricultural Society 20 years ago, and as a frequent witness of the results of maize feeding in Continental Europe, and, to a smaller extent, in America. Briefly then, the extension of arable farming means not only an increase in our production of corn, but a large increase in the production of the food required for stock purposes. On this account I claim that farmers may not only keep large numbers of pigs and entirely destroy our import trade in bacon and hams, thus saving some 30 millions a year, but increase their herds and flocks by 20 to 50 per cent., in accordance with the area ploughed up. It has been proved, to the satisfaction of all experienced men, that an acre of arable land will provide six times as much human food as an acre of grass. Thus my contention is that our arable area should be largely increased by ploughing up the enormous acreage of inferior pasture, and that this should be replaced by the cultivation of the hitherto uncultivated uplands—which, as a number of progressive farmers have recently demonstrated, are able to respond to good treatment.

About the year 1911 or 1912, Sir Everard Hambro sent me a turf from one of the downs on his Dorset estate asking me to suggest in what way the herbage could be improved. This turf, like a second which followed, contained no one useful plant. During the second or third season after the manure suggested was distributed, I visited a number of farms in Sussex, Dorset, Wilts, Surrey, and Warwick, for the purpose of witnessing the results of manuring hill, down, and other poor pasturage, and among them I inspected the down at Coombe Abbey. The result was amazing—the rough sheep-grazing was changed to such an extent that the Bailiff, when asked what he thought farmers would be willing to pay for it, declared that it would let well, and that he would himself gladly pay 40s. an acre if he had the opportunity.

I make two other references to similar good, or ill fortune. A Hampshire tenant slagged a hundred-acre strip on his down land, with the result that it could be distinguished, owing to its rich green colour, for miles around. Asked why he did not manure the whole of this land in the same way, he remarked that he would in all probability lose his farm, as the owner, wishing to sell it, could do so easily enough in its new clothing. In another case, a Midland county farmer, whose unimproved pasturage, like that of a large Sussex farmer whom I also visited, was of the most

viciously bad character, so improved it by liberal manuring that on my last visit some of the pastures were models, feeding bullocks and sheep with considerably less cake, and feeding them so well that the farmer practically regarded a ton of slag as equal in value to a ton of this feeding material. He has, however, had to pay for his courageous enterprise, for his landlord, remarking the success he was achieving, increased his rent by a considerable amount.

I have endeavoured to show not only that the forage grown on arable land, with the addition of the straw produced on the increased area of land devoted to grain, will maintain a much larger number of stock than grass, but also far more than would roots, and at much less expense; and that, with the aid of a silo, a large proportion of that food can be preserved for winter consumption. In no other country do roots play the chief role as a succulent food for the winter. In the United States maize takes their place, as also in some parts of the Continent, whereas lucerne, one of God's greatest gifts to man, so consistently ignored by those who do not grow it, is the chief source of the nutrition of stock in many parts of America, of Argentina, of France, and elsewhere. Where there is doubt existing as to the capacity of a soil to grow lucerne successfully, it should be tested on a plot—conditionally upon the soil being dry, deep, exposed to the sun, and not at too high an altitude. On the question of climate, it may be remarked that it has been grown successfully by the authorities of the West of Scotland College. Lucerne is a rich nitrogenous food which, under good conditions will produce in its second, and several subsequent years, 25 tons to the acre in three cuts and a grazing. It should be drilled across a spring corn crop, on land which has been manured with dung within a few years and has since received a dressing of phosphate of lime. It may be useful to refer to two facts in my own experience as a grower of lucerne for many years in succession. An eight acre arable field having been cropped with lucerne most successfully, it was determined to plough up a poor pasture, to crop it with barley in the following spring and cross the barley with Lucerne. One portion of the field was manured with dung, the remainder with basic slag. The seeds germinated well, but when the lucerne plants on the slagged portion had reached the height of an inch they died off rapidly. On the other hand the plants growing on the dunged land grew with great vigour, and at harvest had reached a height of 14 inches. I concluded that without dung the soil was sterile to the lucerne plant, containing no bacterial vitality. A second point illustrated was the fact that, contrary to the general belief, lucerne will succeed although sown much later than the

stereotyped April date. In 1916 I sowed a plot on June 3rd, and by the middle of September it was ready for cutting—having grown with considerable luxuriance on poor, unmanured, stiff land. Although this plant thrives best on land of a substantial character, there cannot be a doubt but that under given conditions it will grow upon light soils. Staying in 1913 near Quiberon, in Brittany, I found the peasantry growing corn, potatoes, and lucerne on sand overlying granite—which they very persistently tilled and fed with manure. Although with us this soil would remain uncultivated, the experience is, in my judgment, a demonstrative proof of the fact that *the poorest land will respond to the labour of man.*

I am so much impressed with the importance of tillage land that I think it should be increased until at least two-thirds of our wheat is grown in these islands. As arable land produces so much more human food than grass, it is incumbent upon us to extend it to the utmost. The fact that the best of pastures pay sufficiently well is no argument in favour of their retention. It is a question of food, and if these pastures produce more grass than others, it is clear that they would produce more corn as well as more fodder for stock. I cannot, therefore, conclude my reference to corn and potato production without suggesting that we have taken an erroneous view of the question by ploughing up the poor pastures—which can be so easily improved—and by leaving the rich pastures because of the ease and low cost with which they are farmed.

The potato, perhaps more than any other crop grown in these islands, presents an opportunity for the establishment of new industries. Hitherto Germany has almost monopolised the business of manufacturing from it potato starch, farina or potato flour, imitation tapioca and arrowroot, potato chips and flakes, and, perhaps most important of all, alcohol. It has been remarked by Dr. Johnson, who with a colleague has been subjecting the potato to a searching analysis on a large scale, that, of the many millions of tons produced in Germany, three fourths find their way into the above and cognate industries. When the Russian army occupied the oil-fields of our enemies, she was able to maintain the driving power, which was checked by the absence of petrol, by the assistance of potato spirit, which her modified laws enabled the manufacturer to sell at a popular price. This sale was effected under a form of control which, if adopted in this country, would enable us to follow her example in its production for heating and lighting.

The analyses referred to, while confirming the work of Dr. Hindhede, chief of the Danish department of Nutrition, shows,

with great clearness, that the potato differs in quality to an enormous extent. There is not only a marked disparity in the size of the starch grains, as between one variety and another, but a still greater difference in the percentages of starch. This difference is, however, subject to modification where the potato is grown in moist climates, and the results show that the starch present is in an inverse proportion to the water. The small potato, such as that of seed size, contains a higher percentage of starch than the large one.

Of nearly 70 varieties examined it was found that the percentage of starch varied from 22 in Beauty of Bute to 11·7 in Irish White, which stood at the bottom of the list,—the popular varieties:—King Edward VII., Abundance, Up-to-Date, British Queen and Arran Chief—varying from 14·8 to 19 per cent. When Beauty of Bute was grown in the moist climate of Kerry the starch was 17·2, and when grown in Donegal fell to 14·8. The actual production of starch per acre, however, is governed by the weight of the tubers grown, and, when the net yield is shown by combining this weight with the percentage of starch, we find Up-to-Date and Arran Chief near the head of the list with a production of 2 tons of starch to the acre, King Edward and British Queen yielding 1½ tons, and Champion II. with 1·1 tons of starch at the bottom.

Without discussing the fascinating question of the manufacture of potato products, it appears to me that growers will be well advised to select their seeds, not only for their prolificacy and their disease resisting power, but for their richness in starch. On this point manufacturers will be more exacting than the public who, knowing no better, not only ignore the food value of the varieties planted, but by peeling, soaking and boiling, reduce that value to a minimum.

Space prevents further discussion on this subject which must ultimately lead to a large extension of potato culture and to the establishment of industries to deal with it.

MANURES.

This leads us to the question of manures, of which, before 1914, we were the smallest of users. Our consumption consisted of:—

	23,000 tons of Potash Salts
280,000	„ Basic Slag
80,000	„ Nitrate of Soda
670,000	„ Superphosphate
and probably 100,000	„ Sulphate of Ammonia.

We exported some 260,000 tons of this manure, together with 120,000 tons of slag, all of which should have been applied to the land. Thus we robbed our own potential food supply to provide food for our neighbours, among whom were our enemies—and we know the result. The facts were constantly brought to the notice of those who were appointed to watch over the interests of agriculture, but without the slightest result.

OUR LIVE STOCK.

Since the first grant for the purpose of developing agriculture in 1911, it is difficult for an outsider to recognise what has been done. Had it been otherwise, we should not have been caught unprepared at the outbreak of war. Writing in 1893,* I remarked that although the ports of almost any other nation might be blockaded they would still obtain food, but that were *we* subjected to a blockade we should be severely taxed in six weeks, while in six months starvation would be our prevailing condition. Knowing agricultural England as well as I do, and having seen during the past 30 years land apparently waste which has remained untouched by the hand of man, farms half tilled, pastures laid down to grass by nature, and the indifference of all classes of people to agricultural progress—I felt that the danger was grave, and that the necessity for those purely agricultural measures which by assisting to save the country from a more deadly enemy than the foe, ought to have become law many years ago.

The serious inadequacy of our number of stock and of our means of feeding it, is no new fact. In my book published in 1912, and previously mentioned, I showed that whereas in 1890 we spent 19½ millions for imported butter and cheese, that figure rose to 36 millions in 1910, and that while we owned one cow per 16 persons (in 1918 it had become one per 23 persons), Denmark owned one cow per 2·1 persons, France 1 per 5 persons, Germany one per 5·9 persons, Holland one per 5·5, and Sweden one per 2·9. This is largely owing to the greater division of land in these countries. Moreover it is shown in the Report on the Census of production in this country that the small holder keeps more cows and more pigs and poultry per acre than the large farmer, and that he also employs more labour. I nevertheless hold the opinion that both classes of cultivators are essential to the welfare of the State.

In 1911 the cows in Great Britain numbered 2,825,000, whereas they reached 7,538,000 in France (1909), and 10,966,000 in

* Can the Empire feed its people? "Co-operative Wholesale Society."

Germany (1907). In the same year we owned 2,822,154 pigs in Great Britain, a figure now largely reduced; while France owned 7,305,000, and Germany 22,146,000. Need we, therefore, be surprised at our shortness of milk, butter, and cheese during the most vital period of our national existence, or at the fact that we produce so little bacon, and that prices are so ruinous in each case? The Danish farmer feeds his cows chiefly upon arable crops, and his pigs on the skimmed milk available. The French farmer, where his pastures are not rich, as in Normandy, feeds upon lucerne, sainfoin, beet pulp, and green maize, all these being cheap and simple to grow. The German farmer also employs the pulp of the sugar beet for cattle, and the potato for pigs, while the Swiss farmer either feeds his cows on the soiling system or grazes them on the Alps, where I have examined herds at an altitude of 5,000 feet. In this country a 500 feet altitude is regarded as fit only for a rough sheep run.

MILK PRODUCTION.

In agricultural reconstruction it is of prime importance that old practices which are extravagant should be ruthlessly abandoned. Farmers should be led to see past mistakes and to destroy the system under which they have been perpetuated. The cow is a possible exception to the rule that our live stock should be fed upon the produce of the farm, so far as that produce can be grown on the area at command. Unlike the steer or the wether, on which the daily increase of weight is practically limited, there has been for many years no limit to the yield of milk. Although the average production of a cow is approximately 530 gallons, and of butter 150 lbs., it was reserved for Dr. Watney to obtain an average of 463 lbs. of butter in 1904, and over 400 lbs. per annum for nine successive years. Among his Jersey cows were some which produced over 1,000 gallons of milk and as much as 542 lbs. of butter. At a competition which I attended at Chicago, 25 cows averaged 290 gallons of milk in 90 days, while at St. Louis 25 cows averaged 385 gallons, or almost as much as the average cow of this country gave in a year 25 years ago. The two leading cows in this Competition, a Dutch and a Jersey, produced 330 lbs. of butter in 120 days, or more than double the weight produced by an average British cow in 365 days. Although fed on abundance of costly food, by producing 3 lbs of milk per hour during the whole period, the butter cost only 5½d. a pound.

It has been shown both by farmers and scientific experts that, by treating pastures with mineral fertilisers, not only are the pastures

improved, but cattle and sheep fed on them make greater weights than formerly, with smaller rations of cake and grain, or even without rations, while cows yield more milk. What occurs on unimproved lowland pastures which prevail in all parts of the country, and of which I have especially noticed thousands of acres in Sussex, Dorset, Hants, Wilts, and between Gloucester, Cheltenham, and Tewkesbury—also prevails on the uplands, which are equally amenable to cultivation where there is sufficient depth of soil. Increased home production depends as much upon feeding the soil as upon feeding the stock, indeed the former practice is as indispensable as the latter. If British farmers continue to neglect their own land and to rely upon imported foodstuffs, it will be useless to hope for future security. This, however, will not be the case if the suggestions of Lord Selborne's Committee are carried out. The State must stand first, and with every acre tilled and our live stock on the way to improvement, there need be no fear as to the result. Had the best available bulls been selected when the Agricultural Development Grant was first made, there would now have been thousands of cows of improved milking value, and sires sufficiently numerous to serve the whole country.

RECLAMATION OF WASTE LANDS.

Whatever the area of the land which lies waste and can be reclaimed, there is only one course to pursue. The Committee on Reconstruction, while recognizing the supreme importance of this work, raise two points which almost amount to objections. The first is that, owing to the power which the law gives him, the owner of land is able to stand in the way of Government action. The very fact of reclamation being in contemplation will induce him to raise the price to an "exorbitant" figure, thus causing "prolonged delay" to secure his aim. Under such conditions, it is remarked that, with the "existing compulsory powers," the result is likely to be an award which, with the legal charges involved, would "destroy any hope of making the scheme a commercial success." It is evident that where land is returning no profit to its owner, and possesses only a nominal value, the law should be altered to enable the Government to take it at a price based on that value, and reclaim it for the use of the State, which must in future stand before the claims of the individual. Quite apart, however, from this question, I consider that the Government should not make "commercial success" a qualification. Had a hundred millions been spent on the land for the purpose of securing our

food supply 20 years ago, it is possible that agriculture would have occupied a position of greater prosperity, and that the rural population would have been largely increased, that war would have been avoided, or the conditions under which we have suffered would have been much less severe, while men, ships, and money would have been saved. If it is the duty of the Government to secure and reclaim all the waste land in the country, it is also its duty to use it, whether its cost and the expenses involved are covered or not. Every acre is wanted, and if 500,000 acres can be placed in the hands of competent men, on prairie conditions, the nation will reap the resulting benefit, even though the financial loss on the transaction amounts to ten millions.

I have frequently discussed the German system of reclamation, and in this connection Sir D. Hall remarks that in one small Province (Oldenburg), 60 settlers were annually placed on reclaimed land between 1901 and 1910, while the numbers, which rose to 130 in 1910, reached 166 in 1911. Heath, bog, moor, marsh, and sand among the lowlands, and sheep walks in the uplands, are amenable to that rational treatment which the Germans have studied. Of sand reclaimed from near the seashore, I can speak from personal knowledge of the work of the Breton peasant owners in Morbihan. Here, land which in this country would be regarded as barren and worthless, has, by unremitting labour, been induced to grow wheat and other cereals, potatoes of the finest quality, and, above all, useful crops of lucerne. Possession is the main cause of this result, and it might be so with us.

A MINIMUM PRICE FOR CORN.

The increase in our home supply of food depends largely upon another factor of prime importance, viz., the price of corn, and I would almost go so far as to suggest, also upon the price of milk and milk products. The British cheese and butter industry will never expand if prices reach so low a figure as in 1914. These foods may be included among the necessities of life, but if the farmer was practically limited to 8d. a gallon for milk as a year's average, to 7d. per lb. for cheese, and a shilling per lb. for butter, owing to the never ceasing imports and the enormous trade combinations engaged in their sale, he is not at all likely to pursue the Dairy industry with vigour and enterprise, unless prices are permanently higher. In the past, Governments have refrained from protecting the production of food by the imposition of a duty. It has been claimed that food grown abroad, where the value of land and the taxes upon it are insignificant, can

be placed on our markets at less cost than it can be produced by British farmers. The reply that labour is considerably more costly with us, is not taken into consideration, nor the cost of handling and freight. The fact, however, remains that these imports depressed the price of corn to such an extent in the past that over two million acres were permitted to return to pasture, often to weeds, and that the cost of labour has practically increased by 100 per cent. The Committee expressed their opinion, in the sole interest of the nation, and without regard to the profit of the farmer, that the minimum price for wheat should be 42s. and oats 23s. per quarter. Labour must be convinced, as it can be convinced, that if one of its first considerations is just payment for services, so it must equally consider the farmer. It should be recognized that the question is entirely in the hands of the occupiers of the soil, for it cannot produce food without them, and, further, that no class is so easily led or conciliated. The country has no right to ask the farmer to make a sacrifice which will deprive him of that liberty and comfort that, in common with those employed in other occupations, he has a right to enjoy.

It must be admitted that, although minimum prices may be fixed by one Parliament, that Parliament cannot bind its successors. If, therefore, Labour achieves a more powerful position in the control of affairs, that fixture may be abrogated. This possibility should induce farmers to organize, not only for their own protection but for the protection of this country. It is well to remember, too, that a minimum price may be neutralised either by a further increase in wages, or by the raising of rents. If, however, it becomes possible for landowners to raise rent owing to a Government subsidy, it is evident that, just as the farmer who is subsidised, so the landowner who claims part of the subsidy should be subjected to public control—but not the control of the Board of Agriculture. This leads us to recognize the demand for a judicial rent, which control would sufficiently justify. I am of opinion that farmers as a body will not put their heart into the work of production if, with minimum prices, they are still subject to a rise in their rent.

THE QUESTION OF RENT.

There has long been a claim made, even among men holding extreme views, that the Tariff question might be solved in connection with rent. That question I do not propose to discuss beyond its initial stage. If the Committee's view is accepted, the rent receiver, or landlord, will be required in the future to hand over the control of his property to a paid manager, if he treats

it improperly or contrary to the interests of the State. Estate management is to be the landlord's business, as good husbandry is to be the business of the farmer, who is to be ejected under given conditions if he fails in his duty. There can be no tampering with the possession of property. With regard to rent, one word may be said—for it is the key of the question, although it is regarded from different points of view. Ricardo remarked that rent was "that portion of the produce of the earth which is paid to the landlord for the use of the original and indestructable powers of the soil." In the light of modern knowledge, this definition is scarcely correct. Rent is the difference between the produce grown upon cultivated land which is least productive, and that grown upon more productive land. The least productive land would not be cultivated unless the produce grown upon it covered the cost of labour and the interest of the capital employed. When the value of the produce grown exceeds the value of the labour and the interest of the capital invested by the grower, rent commences, and not before. Rents will still have to be paid, for the heart of the nation is just, although it is clear from the Committee's decision, which is based on sound argument, that landowners will have to manage their land under given conditions. It is difficult to lay blame on a class which has devoted itself to the various public duties which must be performed, and has done this well without, speaking generally, receiving any return.

Rents, however, will have to be fair even if not judicial, and it is now recognized that they must not be raised owing to the land having been improved by the tenant, or as the result of a Government subsidy. It is claimed by the Committee that "Fair rent" would involve a Land Court, with all its unwholesome machinery. Such a court of appeal—undesirable as it is—could be obviated by giving the requisite power to the County Agricultural Committees, which, though composed largely of farmers themselves, have already displayed great capacity and fairness in dealing with badly cultivated farms. There are no men more justly severe in their judgment where either landlords or tenants have neglected their duty to the land.

It has been said that careless farmers are stimulated by the raising of their rent. I doubt that. I am able to quote numerous instances in support of that doubt. One thing is certain, that good and true men have been driven from their homes and compelled to commence business again under the saddest conditions, owing to such increases. If, however, a system of judicial rents becomes part of the law, farmers must not

complain if, in consequence of this protection, they are controlled. That the fixing of minimum prices should be followed by the claim of a landlord to participate—by raising his rents—is improbable, but farmers must guard against the possibility.

ALLOTMENTS AND SMALL HOLDINGS.

It is estimated that at Michaelmas, 1918, there were 1,400,000 allotments, of which nearly a million have been occupied since the commencement of 1917. The allotment system was one among other proposals which on many occasions I made in the London press between August, 1914, and 1917, every one of which has since been adopted in a practical form. The co-operation of all classes of the Community is essential in the provision of food.

There are some holders of plots of ten rods of land who are unable to cultivate more, but those who are able to cultivate 20 rods or more should be accommodated, with the object of enabling them to produce not only vegetables but also poultry and pigs. Many a breeder of these classes of live stock finds his way to a farm. Of the worth of the allotment holder one instance alone will suffice. While the average yield of potatoes in England and Wales is six tons per acre, I have found that crops grown on allotments yield at the rate of 16 to 25 tons. Hand labour exacts a more fruitful return, and it should, if for this reason alone, be fully encouraged.

While the Committee on Re-construction express no opinion upon the comparative productivity of the small holding and the large farm, they believe that both are essential to the State. The small holding is the home of many a specialist. As appears from the Report on Production, it employs more labour, feeds more poultry, pigs, and cows, per 100 acres of land, than the large farm, while it is almost the one source of maintaining the rural population. Intending small holders should be permitted the alternative of renting or buying their land, and they should be less cramped by Local Authorities and by the laws which control the construction of their homes. The Canadian shanty has enabled tens of thousands of men to occupy farms, whereas in this country the money which is required to work the land must be invested in a substantial and costly building. Guided by results which have come under my observation, I venture to say that a County Committee, composed chiefly of men who are not practical farmers, should never be the final arbiters either of the suitability of land, of the buildings to be erected upon it, or of the applicants.

Where small holdings and allotments are held under a County

Council, they should be annually inspected by a committee of farmers with the object of the tenant being kept up to the work, or receiving notice to quit.

CO-OPERATION.

In Agricultural Re-construction co-operation must, of necessity, occupy a place, although I believe the principle of co-operation for the sale of produce—except in special cases—is entirely opposed to the interest of small holders and of farmers holding small farms. Nor can I suppose that large farmers will ever lend an ear to any proposal to sell his corn, his hay, or his live stock for him, except through a Co-operative Cattle Auction. In the chief Agricultural Countries of Europe the small holder is at the top of the tree. There were recently in France* 5,702,000 holdings, of which 5,282,000 were under 50 acres in extent. In Germany in 1907, 95 per cent. of the total holdings were under 49 acres. In Denmark (1909) 180,000 holdings out of 249,000 were under 36 acres, while 150,000 labourers owned their houses and lands. In Holland and Belgium it is the same story. These people are large producers of food, including poultry, eggs, rabbits, butter, cheese, cream, pork, fruit, vegetables and honey. In every provincial town in this country, with very few exceptions, these foods are either imported or obtained from the great markets to which they have been sent from other districts. Small farmers should produce and take such produce into the towns for sale; this they cannot do now as the markets have been abolished, so that farmers are compelled to go into the towns to buy from the multiple shop-keeper. Thus, if we take a meal at a farm, we find imported bacon and eggs, butter and cheese, and probably fruit. Vegetables and flowers, jam and honey are usually the product of specialists who send them to London and Manchester for distribution to traders in county localities.

Co-operation for the purchase of manures, food-stuffs, seeds, and the implements of the farm, is an excellent way of saving money and obtaining the best goods, but I venture to say that, with the cost entailed upon the small producer, who sells upon the co-operative system, his profits would be much smaller than if he sold direct to the consumer in a market in his own locality. The system of sale by co-operation involves special packing, the cost of conveyance to a central market, the maintenance of a depot with its staff of employees, re-conveyance to provincial and other retailers, delay

* Statistique Agricole.

and losses occasioned thereby, a return of the empties and losses again, while in no case would perishable goods, such as vegetables and fruit, flowers, butter and cream, be so fresh, and therefore so saleable, as if they were offered to the public in the open market within a few miles of the farm.

EDUCATION.

"Instruction and information have not yet reached the man who tills the soil." Such is the comment of a member of the Reconstruction Committee. Where men are well informed by the processes of study and observation they do some of the best work possible, and I have frequently seen such work in Worcestershire, in Cheshire in Cornwall, and indeed in numerous other counties. While America spends four millions, Canada £840,000, and France over a million on Agricultural Education, the total sum spent by us from all sources in the United Kingdom in 1914 was only £310,000, and this provided for a class which is able to pay substantial fees, rather than for those who cannot pay more than a nominal sum. I have visited Colleges and Farm Schools in numerous countries abroad, and have never found an instance in which the work was not conducted in the interests of men able only to pay nominal fees for their sons. Quite apart from a School or College curriculum, in which practical work should invariably be included, instruction in the form of experiment and demonstration should be carried to the farm. If farmers are to be subject to control, every means should be taken to supply them with information of a practical character, through the agency of experienced men. Leaflets are useful, but are too frequently unread, while the advice supplied by young and inexperienced men who have never occupied a farm or become practical agriculturists can never carry the same weight as that supplied by those in whom farmers have confidence.

I have had the advantage of examining the best demonstration farms in Canada and the State of New York, in addition to many on the continent, and I unwillingly add that we have nothing which is approximately equal to those at Geneva and Madison (U.S.A.), Ottawa, Brandon and Indian Head in Canada, Grignon and Rennes, and Zurich and Berne on the Continent. It is the Farm School which has made Denmark what she is, and not the grandiloquent College which trains numbers of able young men who do not, however, possess practical farming experience to be teachers rather than farmers.

III. THE PROSPECTS FOR DAIRY FARMING.

By A. T. Matthews.

INTRODUCTION.

That the subject with which I am venturing to deal is one of vast importance will, I think, be granted on all sides, not only on account of the huge dimensions of the dairying industry in its various forms, but also because it touches so intimately the whole population. The cost of new milk, butter and cheese may be a small matter to the well-to-do, but even to them the question of quality and purity is a vital one, and, therefore, the whole nation is interested in the produce of the cow.

Such being the case it would be imprudent on the part of any writer to take a partial view and advocate the claims of the producer without paying due consideration to those of the consumer, for in doing so he would find himself ruled out of court by all reasonably well informed critics. At the same time it is to the interest of all parties that the dairy farmer should feel sure of a fair living profit, otherwise the supply may be curtailed to such an extent that prices to the consumer must naturally rise, whether the times be those of war or peace. All parties, including the Government, are agreed that an ample supply of pure milk is a vital necessity for the nation, and the lessons taught by the war have tended to drive home that conviction. Events have demonstrated the danger attending any measures which press unduly on the producer, who has shown an ominous readiness to abandon the business when his interests are unduly threatened.

Farmers have been faced with extraordinary difficulties, among them being the scarcity and prohibitive cost of foodstuffs; the impossibility of securing sufficient labour; the demand for double wages; and the enormous price of good cows. When it was found that the fixed maximum price would not cover outgoings for winter production, while that for summer was too low to counterbalance the certain loss in winter, the farmers raised a protest both by word and deed. The latter consisted of large sales of dairy stock to the butcher, many heifers, which ought to have been available for next winter's milking, appearing in the fat stock markets. This was unmistakable evidence that the farmers were in earnest, and the authorities took alarm and revised the maximum prices forthwith.

This incident bears witness to the fact that the great importance of the milk supply is now fully recognised in responsible quarters,

with the result that producers will be in less danger henceforth of unnecessary interference with their business or unfair treatment at the hands of the Government.

DAIRY FARMING IN THE PAST.

Within easy memory of the older portion of the present generation there has been a great revolution in the character and methods of the British dairying industry, and, as the years pass, there will probably be more changes of equal importance. Thirty years ago the supply of milk from farms situated at considerable distances from great populous centres was only in its infancy, the great towns being mostly served by dairies within or very near their own boundaries. Butter and cheese making were then the rule rather than the exception. Margarine was still under a cloud and was scarcely regarded as a serious rival to butter. Some of the more enterprising farmers in the "eighties" were adopting the new system of milk-selling, and this made great strides in the succeeding decade, for it was found to pay and it saved many a struggling farmer from ruin in those terrible days of agricultural depression. Selling milk, even at 8d. per gallon, was equal to selling butter at 2s. per lb. at a time when the latter was only fetching half that price. Even the milk of Jersey cows formed no exception and, at the time referred to, the writer, with 100 head of this famous butter breed and a model dairy, found it advisable to abandon butter making and sell the whole supply of milk at 1s. per gallon, this being 4d. more than the price then being given for ordinary milk.

There was not much talk in those days of 1000 gallon cows, for the movement for the evolution of the Dairy Shorthorn was only in its infancy. Breeders for the dairy had yet to learn their business, and the great drawback to a really good profit was the poor average yield of the majority of herds. The demand for new milk steadily increased, and more and more farmers went in for its production, until only the very small holders and those situated at long distances from a station continued to make butter.

DAIRYING AND ARABLE LAND.

The writer has long been a warm advocate for a return to cultivation of the land which has been laid down to pasture in recent years, and the necessities of the war may, in the end, turn out to be a blessing in disguise for British agriculture and therefore for the country at large. The policy, now so long pursued, of abandoning the plough, was only the outward and visible sign of adversity

in the form of depressed markets for grain, scarcity of labour and insufficient capital. It was adopted as a refuge in distress and not because it was considered the most profitable system of farming. Incidentally, however, it can be said of it that it has given the land a rest from corn growing, and made it a more valuable aid in these days of national emergency.

What we are here concerned with is in what way the conversion of pasture to plough-land will affect the dairying industry as a whole. It is natural that we should associate dairying with grass fields and grazing, and at first sight, it may appear to many that it must inevitably suffer by the loss of them. Probably a certain number of dairy farmers would reduce the number of their milking herd and perhaps a few would abandon milk production entirely, *for a time*, but there is no reason whatever why there should be any permanent falling off. Experience has shown that, by devoting a sufficient proportion of land to green crops and roots, the business can be carried on with the greatest success without an acre of grass land. More than this, it has been proved that by so doing a considerably larger number of stock can be maintained on the same acreage than on that under permanent pasture. Apart therefore from the question of labour, which will be dealt with further on, it is difficult to see why dairy production should be endangered by concentrated farming, while there are strong reasons for expecting its expansion. All that is necessary is that we should abandon some of our old ideas and move with the times.

BREAKING UP ONLY PARTIAL.

After all, however, no one is contemplating a complete change of system in dairy farming. To break up really fine old pastures that would fatten bullocks without artificials, or to interfere with those used for dairying purposes situated conveniently near to the homestead would be an extreme measure only conceivable under the influence of panic. We are very far from that as yet, though we hear of a few isolated cases of compulsory ploughing very much to be regretted. Political and military events may largely influence the curtailing or expansion of the new cultivations, but the change must be gradual and need not seriously interfere with the dairy farmers' arrangements. Given a reasonable supply of labour, it will be easy for him to adopt a modified form of the soiling system, which would enable him to carry on without parting with a single cow, and this, no doubt, he will do if only he can feel assured of a sufficiently good market for his milk and full liberty of action in his management.

THE IMMEDIATE FUTURE.

Whatever may happen to the dairying industry in after years, the present time is one of anxious crisis, and no one can guess what is in store from day to day. Very threatening clouds are on the horizon which, if the situation were being depicted by one of those clever cartoonists whose work we see in the papers, would be labelled with names to explain them. One of the blackest would be "Com-bines," another "Monopoly" and another "Government Control." Others of smaller size would be marked "Labour Troubles," "Searcity of concentrated Foods" and "High prices for Utensils," whilst those dairy farmers who buy their cows would discern another ominous mass looming over them called, "Fabulous prices for Newly Calved Cows." This is not a fancy picture but one easily depicted by the mind's eye of every farmer who looks ahead.

The combination of the great firms of middle-men is already an accomplished fact, and threatens all parties concerned except themselves. The producers and the consuming public are in the same boat, and may suffer equally if these great "Trusts" are allowed to have things all their own way. The very fact, however, that the interest of the farmers and consumers are both equally threatened may enable an effective resistance to be set up. Already it is being seriously discussed as to whether Government will not be forced to interfere, which they certainly never would do if the producers only were concerned. What they can do, short of taking over the whole business of distribution themselves, is by no means clear. Such a step as that would be regarded by most people, except extreme Socialists, as jumping "out of the frying pan into the fire," but we are told that it is being seriously considered. Fortunately, the thing is too big to be done off hand, and a little enquiry may reveal so many and such great difficulties that the Government may recoil from the task and leave the parties concerned to straighten out matters for themselves. Should this prove to be the result, nothing could be better calculated to stir up resistance on the part of the farmers by way of counter combination, for they would, in fact, be driven to that course. Past experience has shown that nothing short of dire necessity and imminent ruin will induce British farmers to combine on an effective scale, and, faced with such a ring of middle-men as that which is now taking the field, the scale, in order to be successful, would have to be very large indeed. Mere standing out for higher prices from the dealers would not meet the case. Milk is such a perishable article that an attempt of that kind would be foredoomed to failure. Half measures would

be useless, and nothing short of becoming their own distributors seems to offer a chance of victory. That would mean far more than the formation of a huge Dairy Farmers' Union, it would mean gigantic commercial enterprise and the employment of millions of capital. It would be a work of time in any case, but there are no inherent impossibilities and it may have to be done if the dairying interest is to be made secure and permanently prosperous. Here is a task for the Agricultural Organisation Society. It already has its Co-operative Societies which might be used to form the nucleus of a national body for the carrying out of a great national reform. Its grand object would be, not to exploit the consuming public but to do away with the unreasonable profits of the middle-men.

WHAT SUCH A COMBINATION COULD DO.

It may be considered as verging on the Utopian, but in the writer's mind there is hardly a limit to what a powerful combination of British dairy farmers might do by way of reforming their industry, for it would not only establish it on a firm basis, but would also confer an immense benefit on the community at large. What consumers want is a plentiful supply of pure milk at as low a price as may be consistent with a fair living profit for the producer. No one ever complained at having to pay 4d. per quart for a food so valuable and indispensable as milk, and there seems no reason why they should not have it, provided that the producers could get into sufficiently close touch with them. Let us consider the broad fact that, under the existing state of things, the retail price is double that paid to the producer. Granted that the costs of distribution are heavy, there is still a large margin for the middle-men who, notoriously, make excellent profits, which might just as well be divided between the producer and the consumer.

Taking another view of this question of the middle-men, it may well be asked whether it is reasonable that, while milk production is the work of years and is subject every day to risks and worries which have driven many a dairy farmer to despair, the cost of distribution, including trade profits, should equal, as it does, the price paid to the producer.

We now come to the alternative treatment of new milk by a well-arranged system of factories. It is not suggested that the Farmers' Association should encumber themselves with costly and elaborate buildings, but they would, of course, be compelled to have receiving depots, which should be situated close to railway stations and adapted for the manufacture of cheese and butter when and

where necessary, in order to make the very best use of surplus milk. Butter and cheese, skilfully made, would meet with a ready market at good prices and would probably be just as profitable as the sale of new milk, as the farmers would gladly take back the separated milk or whey, at a fair price, for the feeding of calves and pigs. Other alternatives would be the sale of cream or cream cheese according to locality and surroundings.

These direct dealings with the product of the cow would not exhaust the possibilities of a Society of the kind we have in view. Given sufficient enterprise on the directorate, efforts would gradually be made to encourage improved breeding and management of the dairy herd at home, and so, in the course of time, we might see great steps taken towards advancing cheaper production by means of greater average yields, which is the surest way of attaining that object. The system of keeping careful and complete records of the yield of every cow would be encouraged to the utmost, and such rules would be laid down and enforced, if necessary, for both the farm and factory premises as would ensure absolute purity of the goods offered to the public.

This is a programme sufficient for the most exacting. It is not asserted that it will ever be carried out in its entirety, but we do claim that there is nothing in it verging on the impossible.

Before leaving this part of our subject I would like to say that I have no quarrel with the great Dairy Companies as such. They are controlled by keen business men and, on the whole, they have done good work in the past on perfectly legitimate lines. But there are dangers in all great Trusts, and there are grave reasons for objecting to the formation of one in this country which would wield too much power over the dairying industry and the interests of the consumers. It is well to know that there are important companies still holding aloof from the great "Combine." I was talking to a director of one of these the other day and he said "They are trying to get us, but will not succeed in doing so." That was good hearing, for, failing a general combination of producers, it shows that some competition may still be preserved amongst the middle-men. Let us hope, however, that the dairy farmers may be aroused to take steps in their own defence.

THE LABOUR QUESTION.

The question of labour bears very heavily on the milk-producing industry. It has done so during the war with redoubled severity. So far, however, the trouble has been bravely and successfully met.

thanks, very largely to the assistance of our women. The sex has astonished us by their splendid help in every industry and the whole nation is proud of them. Fortunately the work of milking requires less bodily strength than most of our farm work, though it must certainly be classed as skilled labour, and this fact is a very great asset in dealing with the difficulty under the present emergency and will continue to be so whatever happens in the future.

The question before us is whether dairy farming in the future will be able to hold its own under the new conditions, and, so far as can be seen, there seems some reason to suppose that the cost or scarcity of labour will be the determining factor. When the men come back there will be many thousands of women thrown out of employment in other industries who would prefer the milking and tending of cows to a return to domestic life, and these should form a reserve army of willing workers, provided always that the housing problem is satisfactorily solved and proper provision is made for their comfort and well being. Then there is likely to be a great increase in the use of machinery, especially in the districts where labour is exceptionally short and wages are unduly high. Nevertheless, the peculiar conditions under which the work of milking has to be performed render it one of the most irksome of rural tasks. From one year's end to another there is no break; it involves early rising and constant attendance, including the Sunday work to which so many have a rooted objection. Then there are to be half holidays, which will have to be arranged for and will add to the many worries of the employer. It is these worries and the unceasing grind that has made many a milk producer ask himself whether the game is worth the candle and has led him to envy the far easier life of the grazier. These considerations may turn the scale and cause the farmer to abandon the business altogether or at least greatly to reduce his milking herd. While there is little doubt that sufficient hands will always be forthcoming, the position of the employer can never be a bed of roses, and only the attraction of a relatively substantial profit will induce him to retain it.

ALTERNATIVE SYSTEMS OF FARMING.

The foregoing remarks were intended to suggest that the business of dairy farming is not one that is likely to be popular for its own sake, and that should other branches of farming promise equal profit with less work and anxiety it is quite possible that, in the near future, they may displace it to a considerable extent. It does not follow that because milk production was taken up so largely

a generation ago, it will be adhered to under the altered conditions brought about by the war. Its two greatest rivals will be grazing and corn growing, and these will certainly be preferred by many if they are found to pay better than, or even as well as, dairy farming. Whether they will do so is a question impossible to decide at present, for the issue depends on the market prices when importations of grain and meat are resumed on their former scale. Whatever may happen as regards meat, there is scarcely a doubt that, as soon as there is sufficient transport available, there will be enormous importations of grain, and even the minimum price provided by the Corn Production Act may fail to make corn growing at home such a lucrative business as to enable it to displace the produce of the cow to any serious extent. Grazing, however, is on a different footing. It will take years to make good the ravages of war on the cattle breeding industry and, in the meantime, meat must remain at a premium and the battle between beef and milk may be a sharp one for several years after peace is declared.

DAIRY PRODUCE AND FOREIGN COMPETITION.

The advantage, however, for the sellers of whole milk which has always been and is likely to remain with them, is the practical monopoly of the home trade due to the perishable nature of the article. Without this the business could never have formed the refuge in distress which it did in the "nineties," or held the position which it has done for the last thirty years. In spite of all the efforts which have been made to push preserved milk on the market, there seems no likelihood of this very substantial advantage being lost. Of course these efforts have been successful to a certain extent, but the great bulk of the people infinitely prefer to get their milk direct from the cow. Foreign competition therefore will carry no more terrors than it has done in the past, as regards new milk, but we shall certainly return to the old conditions which affected the markets for butter and cheese, and these will be aggravated by the enormous development in the manufacture of margarine, brought about by the war. From this cause the butter trade can scarcely fail to suffer severely, not only by the great increase in the bulk of the substitute, but by its improvement in quality, and the consequent decrease of prejudice against it. With new and improved methods in its manufacture, there may be more hope for cheese as an alternative for surplus milk, but it is plain that the dairy farmers of this country will, in time of peace, have to rely mainly

on new milk for their profit. That, however, will be nothing new to them, for it is long since butter has been in the running against new milk. We may therefore dismiss the danger of foreign importation assuming any new or more threatening aspect than it has done in the past. What is uncertain is the possibility of much stronger competition at home, in the form of other systems of farming which may be more profitable and more attractive. In these days of great changes of public opinion with regard to home production we must leave it to time to disclose the issue.

THE EFFECT OF IMPROVED BREEDING.

We now come to what is perhaps the most important portion of our subject, inasmuch as it deals, not with a speculative forecast of future happenings, but with suggestions of practical measures for making the business of milk production more profitable. In a broad sense there are only two possible ways of doing this, one by driving up prices, the other by cheaper production. The first of these methods, is, and probably will remain, beyond the power of the producer, and may be dismissed without further discussion. Regarding the second, the writer does not pretend to put forward anything new, but only to push forward the consideration of proved facts which go to show that, after all, the prosperity of the dairy farmer is in his own hands. He cannot raise prices but he can cheapen production, simply by increasing the average yield of his herd. A good deal is often said about liberal feeding, but he will never attain his object in that way. It is indeed much more likely that high feeding will tend to decrease his profits rather than to raise them. The royal road to success is by improving the yielding capacity by means of breeding and selection. The first step towards that end must be the keeping of careful records of the yield of every cow at every milking. Half measures are not good enough. Records taken at intervals of a week or a month may be better than nothing, but they will not satisfy the man who really means business. The record system is, happily, already being very largely adopted and is spreading steadily over the country, but, although the farmer who will not move with the times is probably still in a large majority, he should in the future be the exception and not the rule. The next step must be to make a proper use of the records by rigorously weeding out the poorest milkers, thus establishing a minimum yield which can be raised indefinitely as the upward progress is made. The minimum may start at 500 gallons annually, but the object aimed at should not be less than 700 gallons.

BREEDING OR BUYING-IN MILKERS.

The foregoing remarks would appear to imply that the dairy farmer breeds his own stock, but this he does not do as a rule, and here comes in the great difficulty which renders the work of general improvement anything but plain sailing. If every milk producer bred and reared his own stock, the problem of how to cheapen production might soon be solved, but it seems hopeless to expect this yet awhile, and the system of buying-in down calvers will probably continue indefinitely. To the man who only rears for sale there is little inducement, as things are at present, to go to much expense and trouble in the development of milking capacity, and this is just where the shoe pinches. Still, it should not be beyond the wit of man to devise some means of meeting the difficulty. Could it not be made worth while for the ordinary farmer who supplies the milk seller with heifers to co-operate with him? If bulls with strongly marked milking descent were used consistently, and proper credentials of breeding were forthcoming with every cow or heifer offered to the dairy farmer, the buyer would soon learn their value and be prepared to pay a much better price. The creation of such a system of co-operation must be a work of time, but it might be accelerated if the matter were energetically taken up by all agricultural societies which could scarcely devote themselves to more useful work. Although non-breeding milk sellers may largely predominate, it must be that a good proportion of them could at least partly alter their system and start rearing the heifer calves from their best cows, taking care to use sires from proved good dairy strains. "Where there's a will there's a way," and we may be sure that a little successful experience would convert many to the principle of independence and would lead them by degrees to a complete change in their methods. The prizes open to skilful breeding (to say nothing about pedigree) are tempting enough. Not only is the yield of milk indefinitely increased, but, year by year, the value of the herd, as a whole, steadily increases, for nothing in the future will sell better than cows with good records. We can easily ascertain this by studying the results of sales of stock from farms where careful and authenticated registers have been kept, and which show that the enhanced prices have paid many times over for the trouble and small cost of keeping the registers.

Let us now go a step further. The writer has, for many years, advocated the use of the private herd book. A short pedigree is better than none, and costs literally nothing to build up. It will be found in practice that two or three "crosses" of registered bulls

will make a substantial difference to the value of almost any animal, and every additional "cross" will add to it. But especially is this the case as regards milkers, when the progenitors can be shown to have excelled as dairy cattle on both sides. Milk and breeding records should therefore go side by side, for they co-operate in a very decided manner for the owner's benefit. Let "Excelsior" then be the dairy farmer's motto. Let him leave the old, easy-going paths and build up a herd which will appeal irresistibly to buyers as well as fill the pail.

THE QUESTION OF BREEDS.

The question of breed has become a delicate one for the beginner to consider, but to the dairy farmer the choice is far more limited than it is to the beef producer. The writer may have his own views on the subject, but declines to accept a brief for either of the great races of cattle now so prominently to the fore as milk producers in this country. The principles of improvement by breeding and selection, advocated above, will apply to either, and nothing would be gained by extolling the special merits of one's own particular fancy. It is the fashion now-a-days to advocate the superiority of the "General Purpose" cow, and there is much solid wisdom in the contention that neither milk nor beef should be cultivated to an extreme at the cost of the other. It is said that the production of phenomenal yields of milk must injure the constitution and leave us with a decadent race of cattle. The man, however, who aspires to succeed as a dairy farmer must not be too easily frightened by that bogey. There are plenty of thousand-gallon cows to-day which show no signs of loss of constitution, and there is a wide field for improvement before the danger point is reached and "mere milking machines" become the order of the day. The Shorthorn and the Friesian are both by nature "general purpose" cattle and either of these breeds can show plenty of cows giving 800 to 1000 gallons per annum while remaining very useful beefers when their career at the pail is over. There is small danger at present of over-doing the effort for larger milk production. The marvellous advance of the Friesians is a good sign of the coming growth of production. It shows that there is a very strong body of breeders who are keenly alive to the necessity for the country of an ample milk supply, and they are justified in claiming credit for a very large share in furthering the policy of cheaper production. Side by side with them the Shorthorn breeders are working for a similar end, and between them there is every hope of success. The exceptional "records" of quantity, of which we hear, are not of much importance in them-

selves, but they are valuable object lessons to the rank and file of dairy farmers, who have, as yet, scarcely grasped the fact that cows yielding 300 or 400 gallons are only drones and should be eliminated and replaced by others giving at least double that quantity.

POSSIBILITIES.

The records of milk-yielding Friesians and Shorthorns open a wide vista, revealing possibilities which should fire the imagination of those engaged in the industry, but it would be unfair to omit a reference to successful dairying in quite another direction. The performance of Esky Hetty in giving 2413 gallons of milk in 365 days, containing the respectable amount of 3.33 per cent. of butter fat was indeed sufficiently marvellous, but let us see what a Jersey can do in butter production. In some recent trials in the Island no less than ten cows had records of over 500 lbs. of butter in the course of a year, one of them making 528 lbs. in 332 days. At the present price of butter that would mean a gross return of over £50 for the year, to say nothing of the value of the separated milk. Such cases are, of course, not common, but they show that butter-making, under favourable conditions, is by no means out of the running, even as against the sale of new milk. Butter may, and probably will, be cheap when peace comes, for reasons already suggested in this paper, but the choice quality made by Jersey cows will always be a special article and command a special price.

EDUCATION.

But most important, perhaps, of all in the race for success under the new conditions which await us, is that we should take care to cultivate *quality* to the highest possible pitch in every article offered to the public derived from the produce of the cow, beginning with the milk itself. Where butter, cheese or cream is placed on the market, there is nothing like purity and the most excellent quality to ensure its being demanded by the public. To obtain these passports to success we must have both technical and practical education diffused amongst producers. Individual skill may bring prosperity to those who possess it, but in order to capture a market general instruction is required, and this should be the work of our Societies, great and small, assisted and encouraged by the State. It is true that much has been done in the past few years, enough, indeed, to demonstrate the value of education, but the principle should be applied on an infinitely greater scale, and should include the breeding and management of the cow as well as the manufacture of butter and cheese.

CONCLUDING REMARKS.

Forecasting the future is always attended with many risks and pitfalls, especially in dealing with such a complicated interest as that of dairying. All things considered, however, there seems to be no real cause for pessimism in this matter. Once we get back the blessings of peace and normal conditions of trade we shall be in a far better position for estimating our chances as regards agricultural profits. If the well known laws of political economy are a reliable guide, we may be quite sure that the business of dairy farming will find its own level, and ultimately hold its own as a profitable branch of agriculture. It is passing through strange and trying times, like everything else in this troubled world. Some, seized with panic, may abandon it, at least for a time, but it holds in its hand at least one winning trump card, viz :—that it produces an absolute necessity for the public welfare. It is capable of development in many ways, and skill, industry and enterprise in its management will surely meet with their due reward.

IV.—THE ACTION OF LIME IN THE SOIL.

By John Hughes, F.I.C., Agricultural Analyst for Herefordshire.

INTRODUCTORY.

Though lime is a necessary constituent of all naturally fertile soils, and the application of kiln-burned limestone has been practised from a remote period, its action in the soil can scarcely be said to be generally understood.

Bayldon, in his book on valuations, states that there is no subject upon which Agriculturists hold such diverse opinions as that of liming the soil.

Probably this diversity of opinion is largely due to local differences in the composition of the soil—thus stiff clay, rich loams and peaty land are greatly improved by liming, but chalky soils and marls are not likely to be benefited, while light sandy, gravel and granite soils, though deficient in lime, require that it should be added in the milder form of carbonate, such as chalk, rather than in the highly caustic form of quick lime.

Indeed, the composition of the soil has very naturally caused liming to be popular in certain localities and indicative of good farming ; while in other localities it is regarded as quite unnecessary and only a useless expense.

Thus, in the northern and western counties of England, in South Wales and in parts of Scotland, liming used to be very popular, but in the southern and eastern counties where the soil is more calcareous and where, the rainfall being less, the climate is drier, it has not been customary to apply lime in its ordinary caustic form, though much benefit was frequently found to result from dressings of chalk and chalk marl at intervals of about 20 years.

No doubt the excessive quantities of lime sometimes applied in the past did much to discredit its utility, and the too frequent application gave rise to the saying that "lime is good for the father but bad for the son."

Lime acts beneficially as an alterative on the substances contained in the soil, both organic and mineral, but should not be applied in excess, because the growing crop can only utilise a certain proportion of lime, and of the plant food rendered available by the application of lime, so that the excess of such plant food as well as the excess of lime is simply wasted and carried away in the drainage water; the soil being proportionately impoverished for future crops.

The introduction of artificial fertilisers about the middle of the last century also largely contributed to the disuse of lime, because it was assumed that these manures supplied all the lime necessary. But as superphosphate, dissolved bones, and the various compound manures applied to root crops, are in themselves acid, and exhausters of lime in the soil—which passes away in the drainage as sulphate of lime—the application of lime should really be more necessary now than formerly.

Liming in the last century was associated with summer fallows, but, with the decline in the price of corn, this somewhat costly preparation for wheat had to be given up, and the old custom of applying lime to arable land during the summer and autumn appears to have been, at the same time, extensively abandoned; the numerous ruined lime kilns in certain districts afford practical evidence of this fact.

At the present time there is an evident revival of liming the arable land going on throughout the whole country, as may be noticed when travelling by train, for one sees heaps of lime and chalk put out on the ploughed land. It is best to apply lime on the surface *after* ploughing rather than *before* ploughing, because lime has a natural tendency to work downwards.

ACTION OF LIME IN THE SOIL.

Bearing in mind that at the present time ordinary burnt lime, commonly known as *quick* or *caustic* lime, costs probably more

than three times as much as chalk, it may be well to consider what is the action of caustic lime when applied to and mixed with the soil; and whether to apply chalk instead would not be cheaper and more economical.

Caustic lime when mixed with damp soil rapidly becomes converted into carbonate of lime, the relative rapidity of such conversion depending upon the presence of moisture in the soil, for if mixed with air-dried soil and kept under cover and protected from rain, the carbonation process proceeds very slowly as will be seen from the following experiments.

A red hop-yard soil from Hereford and a loamy soil from a golf links green in Kent were selected and carefully air-dried and then analysed with the following results.

TABLE I.

Composition of the soils in the air-dried state.

	No. 1 Hereford Hop-yard.	No. 2 Kent Golf Green.
Water (lost at 212°F)	2.77	5.10
*Organic matter and Combined Water	3.85	14.97
Oxides of Iron and Alumina	8.77	7.32
Lime ... ..	.69	1.61
Magnesia ... ..	.85	.19
Phosphoric Acid ... ..	.14	.08
Carbonic Acid... ..	Trace	.47
Potash ... ..	.28	.23
Insoluble Silicious Matters	82.65	70.03
	100.00	100.00
*Containing Nitrogen	.17	.40

From the soils named, a compound was in each case prepared by mixing 20 parts of well burned caustic lime, containing by analysis 91.61 per cent. of total lime, with 80 parts of the respective soils.

The amount of carbonate of lime in the compound was then determined very carefully on May 13th, 1918, the date of the commencement of the experiments. Each of the compounds so prepared were then divided into two equal portions, one of which was placed inside the laboratory window and the other was moistened completely with distilled water and placed outside exposed to the north and allowed to remain till May 21st, by which time the moisture had dried and the surface had become hard and set firmly.

The proportions of carbonate of lime were then determined on the following dates, and, in the case of the outside portions, water was added after each determination, and sufficient time allowed to dry and the surface become hard, before again determining the amount of carbonate of lime.

The inside portions were kept all the time without the addition of any external moisture and remained in a dry powdery condition.

TABLE II.

Showing the progress of carbonation in dry and damp soil.

				Hereford.		Kent.	
				Hop-yard. Dry.	Damp.	Golf Green. Dry.	Damp.
May 13th,	Percentage of Carbonate						
	of Lime ...	...	...	1.13	1.13	1.59	1.59
May 21st,	ditto	...	...	5.23	15.91	5.42	9.09
May 27th,	ditto	...	...	5.45	20.70	5.43	14.54
June 12th,	ditto	...	...	5.70	21.60	5.45	18.40
June 25th,	ditto	...	...	5.70	21.60	5.69	21.36

TABLE III.

Showing the respective condition of lime on June 25th.

				Hereford.		Kent.	
				Dry.	Damp.	Dry.	Damp.
Lime (as Carbonate) ...	...	...	...	3.20	12.09	3.19	11.96
Lime (as Caustic) ...	...	...	...	8.96	none	7.52	none
Lime (in union with Organic Acid)	...	...	...	none	1.06	1.26	1.44
Lime (as Silicate) ...	...	...	...	2.84	1.30	4.83	1.44
Total				15.00	14.45	16.80	14.84
Water (lost at 212°F)	...	...	...	1.64	4.14	3.76	4.40

From the foregoing figures it will be seen that the lime in the soils which were kept dry inside only became carbonated to a very limited extent during the six weeks, namely, from 1.13 to 5.70 in the Hereford soil and from 1.59 to 5.69 in the Kent soil.

On the other hand the lime mixed with the soil placed outside exposed to the weather, and to which water was added after every determination of the amount of carbonate of lime, increased from 1.13 to 21.60 in the Hereford soil, and from 1.59 to 21.36 in the Kent soil.

It is interesting to notice that the carbonation increased earlier and more rapidly in soil No. 1, which, by analysis, contained only 3.85 per cent. of organic matter and combined water than in No. 2, which contained as much as 14.97 of organic matter and combined water. According to the figures in Table III. fully three quarters of the lime remained in a caustic state in the soil kept dry inside the laboratory even at the end of six weeks, whereas there was no caustic lime left uncarbonated in the soil kept outside, and which received added water at regular intervals.

Further, in the case of the two soils kept dry, there is a tendency to form compounds insoluble in water such as silicates, thus 2.84 of the lime in the Hereford soil and 4.83 in the Kent soil were so changed. On the other hand, when the soil is kept more or less damp as occurs practically in the fields, there does not appear to be the same tendency for the lime to become converted into compounds insoluble in water.

PRACTICAL DEDUCTIONS.

From these experiments it will be seen that lime when mixed with damp soil rapidly becomes converted into carbonate of lime, and it must be borne in mind that in practice the proportion of caustic lime instead of being one part to five parts of soil as in the experiments, would probably be not more than one part of lime to 1,000 or more of soil, the rate of carbonation would probably be still more rapid than these experiments have indicated provided the lime were in a fine powder, and at once mixed with the damp soil.

Hence, lime should be mixed with the soil as soon as possible and not be allowed to remain in heaps on the field, where, under the influence of much rain, it may be converted into a kind of mortar difficult to spread.

As caustic lime, when mixed with soil, so rapidly becomes changed into carbonate of lime, such as exists in chalk, it would appear from these experiments that the good effects of liming are really due to lime in the form of carbonate.

For instance, on strong stiff soils such as clay the flocculating action of lime in causing the fine particles of clay to aggregate or collect into larger particulars, results in making the soil of a coarser texture so that the water will pass away and the land become of a less retentive character, and consequently drier and warmer, so that crops come to maturity earlier and are of a better quality.

In Gloucestershire, Herefordshire and Worcestershire alone, there

are thousands of acres of red soils which would be greatly benefited by the application of finely ground chalk or limestone in a powdery condition.

In all such red-sand-stone soils, which are somewhat deficient in accumulated vegetable remains, the ordinary caustic or quick-acting lime causes a too rapid oxidation of the vegetable matter, and if applied in the large quantities formerly customary has a tendency to burn and destroy the valuable water-retaining organic matter.

Indeed, as already mentioned at the commencement, lime is a necessary constituent of all naturally fertile soils, but it acts chiefly as an *alterative* in converting the soil ingredients into available plant food, for, though specially necessary for certain crops such as turnips, swedes, mangolds, hops and clover, yet the cereals such as wheat, barley and oats do not remove in an average crop more than 10 to 12 lbs. of lime per acre of which fully 9 lbs. is associated with the straw which in good farming should be largely returned to the land in the form of dung.

But be it noted that it was customary to apply lime to the *summer fallows* in preparation for autumn sown wheat, because lime acts upon both the mineral and the organic constituents of the soil liberating the potash and phosphoric acid as available plant food, and converting the organic nitrogen compounds into nitrate easily assimilated by the growing rootlets of the future crop.

There is no doubt that lime is best applied to land in the arable condition so that it can be chain-harrowed and intimately mixed with the fine particles of soil rather than applied directly to land when in grass where it must remain on the surface and can only slowly penetrate the soil.

SOLUBILITY OF CARBONATE OF LIME.

Caustic lime, when converted into carbonate of lime through the combined action of moisture and carbonic acid in a damp soil, becomes much less soluble, but the continued action of soil water charged with carbonic acid gradually converts the carbonate of lime into the well known form of bicarbonate of lime from the absorption of carbonic acid. This bicarbonate of lime acts on the silicate of potash existing in the soil rendering the potash available for the growing crops.

In this respect, a dressing of chalk applied at Rothamsted to some plots in permanent pasture in 1881 produced a very visible and favourable improvement in 1884 in the quality and character of the herbage, there being a marked increase in the proportion of clover and similar leguminous plants.

For the purpose of comparing the respective solubility of caustic lime and carbonate of lime, and also for showing the effect of carbonic acid as a solvent, distilled water respectively *boiled* and then cooled and *unboiled* distilled water as obtained from the condenser, were employed.

TABLE IV.

Relative solubility of *caustic lime* and *carbonate of lime*.

- 1 part of caustic lime dissolved in 720 parts of cold boiled distilled water.
- 1 part of carbonate of lime dissolved in 25641 parts of cold boiled distilled water.
- 1 part of carbonate of lime dissolved in 22728 parts of unboiled distilled water as obtained from the condenser.
- The distilled water as obtained from condenser contained .02816 parts carbonic acid in 1000 parts.

It will be seen that caustic lime dissolves readily in a very small quantity of cold water compared with carbonate of lime, and it should be remembered that every part of carbonate of lime contains only about half its weight of lime, as 100 parts of pure carbonate of lime consist of 56 parts lime and 44 parts carbonic acid.

It will also be seen that a larger quantity of *cold boiled* distilled water is required to dissolve one part of carbonate of lime than is the case with the *unboiled cold distilled* water, because distilled water, as it comes from the condenser, contains a varying amount of carbonic acid which increases the solvent action of the water.

It is important to bear this fact in mind as it explains the solvent action of soil water on soil ingredients, for such water always contains carbonic acid derived from the air and the vegetable matter existing in the soil. Hence, if the soil be calcareous, and naturally rich in lime, the drainage water becomes charged with lime in the soluble form of bicarbonate.

But in order to have such soil water well charged with carbonic acid it is necessary that the soil should contain plenty of easily decomposed vegetable remains, hence the application of lime whether as caustic, or as carbonate should be followed by a dressing of dung unless the soil contains naturally an accumulation of vegetable matter, as in the case of old pastures, rich loams, or peaty land. Indeed, on such soils it would be a great waste of valuable manure and of money to apply dung as well as lime.

Usually, however, soils that are deficient in lime, such as sands, gravels, granite soils, and clays are also deficient in vegetable matter as well as in lime, so that dung or some organic material is required in order to get the full effect of the lime applied.

LIME AND MAGNESIA IN SOILS.

The proportional amount of magnesia existing in soils in comparison with lime has attracted a good deal of attention during recent years, and agricultural writers have expressed somewhat opposite views respecting its possible utility or the possibility of its presence being regarded as positively injurious under certain conditions.

Magnesia itself possesses causticity in a very feeble degree compared with lime, but its salts, such as carbonate of magnesia, chloride of magnesium, and sulphate of magnesia, popularly known as Epsom salts, all possess medicinal properties of a purgative character.

In Agriculture, magnesia has hitherto only been applied in combination with lime in the form of dolomite (magnesian limestone), such as Breedon lime either burned or finely ground.

At Woburn, during the last ten years, a series of exhaustive experiments both in 34 lb. pots and on 1-20th acre plots have been conducted by Dr. J. Voelcker with a view of ascertaining whether the addition of magnesia to soils deficient in this constituent would be beneficial or otherwise as compared with the addition of lime.

Buxton lime, and Yorkshire magnesian lime at the rate of one ton per acre, and Buxton limestone and Yorkshire magnesian limestone finely ground at the rate of 1·6 tons per acre, were applied to the ordinary Woburn soil containing about ·26 per cent. lime and ·09 per cent. of magnesia.

The experiments were made in pots containing 34 lbs. soil, and the lime and ground limestone were mixed with the top three inches only, in order to imitate what would be done in practice. The crop grown was wheat.

The results showed that on this particular soil the burnt lime was inferior to that of finely ground limestone, and that magnesian limestone, whether in a finely-ground state or burnt into lime, had not given as good results as the pure carbonate of lime.

On another Woburn soil containing lime ·40 and magnesia ·20 per cent., caustic magnesia was mixed with the soil in proportion sufficient to raise the percentage of magnesia respectively to ·28, ·35, and ·50 per cent. The results in the wheat produced showed an increased yield of grain until the percentage of magnesia was equal to that of lime, but as soon as the magnesia exceeded the lime there was a decided decrease.

SOIL CONTAINING MORE MAGNESIA THAN LIME.

A red clay soil from Hereford, which would not produce good crops of corn, and containing lime ·83, magnesia 2·29 per cent., was

operated upon at Woburn in 34 lb. pots, Buxton lime being added sufficient to raise the percentage of lime respectively to 1·25, 1·50, 1·75, 2·00, and 2·25.

The yield of wheat showed an increase for the 1·25 pot, but a steady and proportional decrease for the remaining pots.

No doubt the quantity of caustic lime added was far too great and consequently the alkalinity of the burnt lime had an injurious influence in lowering the crop yield.

Presuming that the lime was only mixed with the top three inches of soil, the increase in the contents of lime from ·83 to 1·25 per cent. would represent an application of something like 20 tons of caustic lime per acre, which is really a heavy dressing for a soil containing probably little vegetable matter, and it is not surprising that the other pots containing the higher percentages of lime showed a proportionately decreased yield of wheat.

The Hereford soil referred to in Table I. as taken from an old Hop-yard contained ·85 magnesia and only ·69 lime per cent., and on such a soil with only 3·85 of organic matter and combined water, finely ground chalk or the dried precipitated lime sludge obtained by Clarke's process of softening hard water, applied at the rate of one to two tons per acre, would be the most economical and efficacious dressing for supplying lime.

Indeed, this soil may be regarded as typical of the soils upon which lime in the form of finely ground chalk or limestone is the most suitable dressing for increasing the lime contents so that the percentage may be greater than that of magnesia.

The general results of the Woburn experiments appear to indicate that, though the application of magnesia to soils deficient in this ingredient may increase the yield of wheat, more economical results will be obtained if the alkalinity of the soil be increased by the application of lime, either in small quantity as finely ground caustic lime at about 10 cwt. per acre, or as finely ground chalk or limestone in larger proportion, namely, one to two tons per acre.

Magnesia, even if satisfactory, is not practically available for agricultural use, whereas lime in some form can usually be obtained throughout the country.

In conclusion, it may be safely assumed that where the percentage of lime is less than that of magnesia, lime in some form is requisite. Also, that when the percentage of lime exceeds that of magnesia, but is less than one per cent. in the air-dried soil, the application of lime is generally desirable and likely to be attended with beneficial results.

Care should be taken that the mechanical condition is as fine as

possible, and that where the soil is light and contains little vegetable matter the dressing should be in the form of carbonate rather than as the ordinary caustic lime.

For particulars of the different kinds of lime and limestone the writer would suggest reference to his paper on "The Importance of Liming," published in the Society's Journal for 1917.

THE PRESENCE OF LIME AND MAGNESIA IN HEREFORDSHIRE SOILS.

Since the above paper was placed in the printers' hands the writer has completed the examination of eleven soils from Herefordshire specially selected at the direction of the Agricultural Committee of the County Council by Mr. John Porter, B.Sc., the Agricultural Adviser for the County, with a view of ascertaining the relation between the lime and magnesia, as from practical experience it had been found that full crop results were not obtained when magnesia existed in larger proportion than lime.

The soils, when received in November, were all more or less damp, and had to be air-dried, then broken up into a fine condition and finally dried at 212°F. before being analysed.

Lime and Magnesia soluble in hydrochloric Acid solution were determined in all the soils, carbonic acid in the two soils that contained the most lime, and sulphuric acid and chlorine in the soils that contained the most magnesia.

No.	100 parts of the dried soils contained				
	Lime	Magnesia	Carbonic Acid	Sulphuric Acid	Chlorine
1	49	34			
2	25	1.23		.013	.008
3	78	1.05			
4	63	1.20			
5	2.51	.85	1.22		
6	30	.60			
7	2.49	1.09	1.11		
8	21	.36			
9	.99	1.35		.015	.007
10	.15	.27			
11	.33	.61			

It will be seen that magnesia is in excess of the lime in eight out of the eleven soils; also that in soils 5 and 7, which contain the most lime, the percentage of carbonic acid is not sufficient to combine with the whole of the lime, for in No. 5 the 1.22 carbonic acid would only require 1.55 lime out of a total of 2.51, and in No. 7 the 1.11 carbonic acid would require only 1.41 out of a total of 2.49.

The remainder of the lime, namely .96 in soil 5 and 1.08 in soil 7,

is probably present as silicate of lime, a compound which is less soluble than carbonate of lime. Magnesia being a weaker base than lime is not likely to exist as carbonate because, as just shown, there is not sufficient carbonic acid.

The figures for sulphuric acid and chlorine are so small that the magnesia is not likely to exist either as sulphate or chloride.

In order to ascertain to what extent both the lime and magnesia existed in a form likely to be available as plant food, weighed portions of soils 2 and 9, which contained the most magnesia, were separately exhausted for 24 hours with a very weak solution of citric acid, namely, 1 part citric acid to 1,000 parts cold distilled water acting on 5 parts of the finely-ground soil in a large beaker with occasional stirring.

Solubility in a cold 1 in 1,000 solution of citric acid.

Percentage of	Lime	Magnesia
No. 2 soil yielded	.24	.03
No. " "	.57	none

It will be seen that the whole of the small quantity of lime, .24 in soil 2 was dissolved, but only a mere trace of magnesia, namely .03 out of a total of 1.23; also that in soil 9 out of a total of .99% lime .57 was dissolved but absolutely no magnesia.

This specially weak solution of citric acid was introduced by the writer in 1900 as a standard solvent for demonstrating the great solubility of a new manure known as basic superphosphate 94 per cent. of which readily dissolved in this solvent. This solution represents an acidity absolutely below that of the sap of all farm crops. Consequently it may fairly be claimed that all phosphate and carbonic of lime dissolved by such a solution, representing an acidity of .10 citric acid per cent., may be regarded as existing in a condition readily available as plant food.

CONCLUSION.

1.—From the above analysis it would appear that the lime in these soils exists partly as carbonate, which is available as plant food, and partly as silicate of lime, which is not so readily available.

2.—That the magnesia exists not as carbonate, sulphate, or chloride, but as silicate, in which state it is not likely to be readily available either as plant food or as a nitrifying agent in the soil.

3.—That it is not the excess of magnesia in certain of these soils but the deficiency of lime that has caused the crop results on such soils to be unsatisfactory.

4.—That all the soils, with the exception 5 and 7, will be greatly benefited by the application of lime.

5.—That, as all these red sandstone soils contain only a moderate amount of vegetable matter in the form of humus, lime would be more suitably supplied in the form of finely-ground limestone or chalk, or as precipitated carbonate of lime from water works or paper manufactures, than as freshly-burned quick lime, which would tend to burn up or too rapidly oxidise the humus which constitutes such a valuable ingredient of all fertile soils.

V.—FOREST-MAKING IN THE UNITED KINGDOM.

By S. Leonard Bastin.

During the War there has been a heavy drain on natural resources of all kinds. With the coming of peace many countries will be faced with a most serious shortage of the more important raw materials. In some instances the difficulties may be surmounted in the course of a few years; in others a generation or more must pass before matters can be righted. In this latter category must be placed the question of timber supply. The destruction of forests, for purposes connected with the War, has proceeded at a rate which the most provident community could not have foreseen. At the present time the reserve of timber in the whole of north western Europe is lower than it has been within living memory. Yet, with the period of re-construction, which is coming the demand for all grades of wood will be colossal, second only to that call in connection with the War. In these circumstances it is a matter of great moment to consider the position of the United Kingdom with regard to this question.

FORESTS IN THE UNITED KINGDOM.

It is common knowledge that the upkeep of forests in this country has been sadly neglected. The following table compiled a few years ago is instructive as showing the percentages of wooded areas in the leading European countries.

England	...	...	...	...	5·3
Scotland	...	...	...	...	4·6
Wales	...	...	...	...	3·9
Ireland	...	...	...	...	1·5

Denmark	...	...	...	...	7·2
Holland	...	...	...	...	7·9
France	...	...	...	...	17·0
Belgium	...	...	...	...	17·3
Germany	...	...	...	...	25·9
Hungary	...	...	...	...	27·5
Austria	...	...	...	...	32·6

In considering these figures it must be borne in mind that much of the wooded areas in the United Kingdom could not be called first class forests. The trees are often of poor quality—largely owing to the indifferent amount of attention they secure. On the other hand the greater part of the wooded areas on the Continent are under the strictest control. The right trees are grown in the right way and naturally the best results follow. During the War we have made vast inroads on our limited amount of growing timber. To-day, the major part of our wooded areas is gone and that which is left is largely of inferior quality. Here and there something has been done towards re-planting, but there has been no general scheme of re-afforestation. The situation is one which demands immediate attention if we are to make certain that our supply of timber for the future is secured. Unhappily, nothing that we can do will provide us with an adequate amount of home-grown timber quickly. Roughly speaking the great needs in this direction are (1) pitwood for collieries and (2) timber for other purposes. To produce the former it will take from 15 to 35 years and the latter from 45 to 60 years.

GOOD TIMBER CAN BE GROWN IN THE UNITED KINGDOM.

There is no doubt at all that the British climate is well suited for the growth of trees. Hundreds of years ago these islands were covered with vast natural woodlands to a considerable extent. In the course of time these were cut down for economic purposes or cleared to make room for pasture and cultivation. These ancient forests were largely composed of oak and beech in the southerly parts of the kingdom and conifers and birch in the more northerly regions. It has been proved that many kinds of exotic trees grow well in the United Kingdom and the best results have attended the planting of the Douglas Fir, the Japanese Larch, and several species of Spruce, to mention only a few coniferous kinds. Indeed, suitable soil and climatic conditions are to be found in our islands for almost any of the timber trees that will flourish in a temperate region.

WASTE LAND AVAILABLE FOR TREE PLANTING.

Obviously, in considering the question of forest-making, it is important to realise that our agricultural areas cannot be encroached upon. Thus the new woods must be established almost entirely on waste land. What is the amount of waste land available in the United Kingdom that would be suitable for tree planting? In a report issued by the Royal Commission on Afforestation, sitting in 1906, it is stated that 9,000,000 acres could be converted into woods without seriously affecting the area under cultivation. Nowadays we must regard this as an outside figure owing to the demands of agriculture on the land. Then, again, much of the waste land is not of the best character even for forest making, although it cannot be emphasised too strongly that useful timber can be raised on ground that is not by any means of an ideal character.

In a general way the areas of waste land may be roughly classified in the following manner :—

- (1) Rough mountain pasture.
- (2) Moorland with peat bogs.
- (3) Low lying marshes and swamps.
- (4) Sandy stretches near the sea.

Probably a good deal of the land which is now mountain pasture was at one time clothed with woods. From an agricultural point of view the value of these elevated areas is not considerable, but the establishment of certain woods is possible even up to 2,000 feet above sea level if the planting were scientifically carried out, and forests of birch and some of the conifers could profitably be formed. Moorland and peat bogs, often over an impervious clay, present a much more difficult problem. Here the soil is usually sour and badly aerated and the conditions are very unfavourable to tree growth. Yet there is reason for believing that many of our peat bogs were formerly forest areas. Remains of birch and pine have been discovered in bogs where at the present time there are no trees within sight. By drainage, much could be done to re-claim these vast bogs and bring them into forest condition once more. In the low-lying swamps and marshes the soil is not sour but it is cold and saturated with moisture. Here again, nothing in the way of tree planting can be carried out until the ground has been drained of its superfluous water. Finally, one may consider the sandy stretches which occur at intervals round our coast. These are not considerable, although there is more ground in this condition

than is commonly supposed. The sandy areas are difficult to deal with for two reasons. The loose soil, until it is fixed in some way (as by grass), is constantly being moved about by the wind. Instances are on record where plantations of small trees have been completely buried by the sand drifts in the course of a few stormy months. Then, the strong sea winds are likely to hamper growth until the trees become large enough to afford shelter to one another. Still, forests, both natural and artificial, exist in close proximity to the sea, notably on the shores of the Baltic. Even in the most exposed positions the trees are able to hold their own when once the wood is established.

CONDITIONS TO BE CONSIDERED BEFORE TREE PLANTING.

Before anything in the way of tree planting is attempted many points must be considered. The land must be brought into the best possible condition, and, to this end, schemes of drainage and general preparation have to be taken in hand. On very wet soil drainage is a matter of supreme importance. Ground in this state is cold and great root activity is impossible until the state is improved. Ditches to carry away the superfluous water are usually the only practicable way when dealing with large areas. Then the ground must be cleared as far as possible of weeds, heather, furze, etc. Much of this stuff can be disposed of by setting it on fire during dry spells, the ashes from the destroyed plants helping to enrich the soil. Then it pays to break up the soil on the surface as far as possible. It should never be forgotten that the more thorough these early preparations are the better, for, after the plantation has started, cultivation is only possible to a limited extent.

An important matter is the selection of the kinds of trees best suited to the locality. First of all, the soil and climate have to be considered. In a crop that takes so long to mature, it certainly pays to leave no stone unturned to have the trees growing under conditions that will ensure a satisfactory development. But almost as important is the question of the needs of the district. The ultimate profit from any timber crop is largely determined by the demands of the locality. So much is this the case that land near coal pits and wood-consuming areas may promise far better returns than soil of equal, or even better, quality in parts of the country where there are no industries requiring a timber supply. A very interesting instance of this which is deserving of a special reference is seen in connection with the work of the Midland Re-afforestation Association.

MIDLAND RE-AFFORESTATION ASSOCIATION.

This association was founded about fifteen years ago with the object of making good use of the vast acreage of land in the Black Country that had been laid waste owing to the operations of the iron and coal industries. It was pointed out that, years ago, the Midlands were fairly well wooded, even if they could not be described as forest country. Old prints show that within the last century there were extensive wooded tracts in more than one district where to-day there is hardly a green thing to be seen. The trees had been cut down and had not been replaced, largely owing to the widespread belief that vegetation could not flourish in the smoky atmosphere. In addition, it was asserted that nothing would grow on the heaps of pit refuse, but close observers could see that, after an interval, Nature herself started to clothe the barren mounds with weeds. As a matter of fact, about the only positions in which it seems well nigh hopeless to attempt tree planting are those in close proximity to chemical works. Even there positions are not hopeless for, with modern appliances, there is a tendency to check the emission of harmful fumes. The difficulties of forest making in the Black Country are not, it should be noted, entirely due to artificial conditions. These parts of the Midlands are largely situated at a high level, and are fully exposed to all the winds that blow. Well-established plantations flourish, but it has not always been an easy matter to make a start. It was found that seedling trees from well-managed nurseries often failed, simply because they could not stand the bleak conditions; roughly raised material stood a better chance. In the formation of the first woods thick planting was the rule so as to allow for a number of failures. Curiously enough the loss of trees has not worked out to be heavier than that sustained in the average English plantation. Wherever trees are planted, the grower can reckon on a loss of from 10 to 15 per cent. during the first year. In these Midland plantings the loss has always been well within the 15 per cent. limit.

In the neighbourhood of active coal mines and smelting furnaces conifers will not thrive. The evergreen foliage soon becomes choked with dirt and the trees suffer badly. But in worked out areas pine trees flourish well and promise to yield good results. The greatest success has attended the planting of the following trees: Black Alder, White Alder, Black Poplar, Willows of sorts, Wych-Elm, Birch, Ash and Sycamore. The Alders have proved to be marvellously accommodating, and one can see sturdy trees growing

on mounds that are little better than coal dust. Poles of Alder of a saleable size are ready in fifteen years from planting, and there is probably no more profitable tree to grow. Owing to the curious matted root formation of the Alder, this tree is able to retain moisture even in very dry soil. Thus, although it is not a good subject for imperfectly drained positions, it is useful in conserving moisture, where this is deficient, and helping the growth of other trees. Anyone who wishes to see what can be done in the way of tree planting under really unfavourable conditions of soil and situation should certainly pay a visit to some of the woods established by the Midland Re-afforestation Association. From a business point of view the scheme promises to be a great success. The local demands for timber for mines and other purposes is very great. Several mining companies have been so impressed at the results of the society's work that they are converting their own pit mounds into plantations.

SOME OF THE MOST IMPORTANT TIMBER TREES.

It will be interesting to consider a selection of some of the most valuable timber trees that are specially suitable for planting in the United Kingdom.

OAK (*Quercus pedunculata*, etc.) Economic value.—Oak is used for a great variety of purposes such as building, carpentry, fencing, etc. Poles of oak from the smaller trees are used in mines. The American Oak, which has been so largely imported in recent years, is nothing like so durable as English timber.

Soil, etc.—A good oak soil is that where there is a heavy deep clay in which the roots can thrust freely downwards, but where the soil is light the variety known as the Sessile Oak is better than this species. The rapidity of development and the quality of the timber in the case of the oak depend very largely on the nature of the soil. Oak trees are always seen at their best in fairly sheltered situations. Oak coppices are profitable, and these are very common on the Continent. The length of time required for the maturity of the oak timber often makes it desirable to plant some other kind of tree as well.

Oaks are raised easily from acorns in seed beds. These youngsters are ready for planting out in four or five years.

BEECH (*Fagus sylvatica*). Economic value—Beech is a tough, durable timber lasting even longer than oak when used as poles in the ground. It is extensively employed in the making of wagon-shafts, cart poles, furniture, etc.

Soil, etc.—The beech grows best on a light deep soil where a fair amount of moisture is available. It is not a satisfactory tree to plant on clay. The best beech woods exist in southern England though there are some finely-wooded areas of this tree in the Midlands. Beech is useful as an undergrowth to oak. It plays a useful part in this respect, seeing that it helps to screen the ground often unduly exposed to sun and air through the imperfect shelter given by the oak branches.

The beech is readily raised from seed. After two or three years the little trees are ready for planting in the woods.

ASH (*Frazinus excelsior*). Economic value—Ash is extensively employed in the making of agricultural implements. The smaller coppice wood can be freely sold for hop poles, hoops, crates, etc.

The ash is one of the most profitable trees, quick of growth, and producing a timber that is useful in almost all sizes.

Soil, etc.—A light loamy soil is the best for the ash and a good amount of moisture is required. The situation of an ash wood should not be very exposed if the best results are desired. Ash grows well as an underwood in its young state in conjunction with oak, sycamore, willow, etc.

The ash is raised from seed and it develops with great rapidity after the second year.

COMMON ENGLISH ELM (*Ulmus campestris*). Economic value—Elm is used for furniture, coffins, etc. Wood produced on good soil is very durable.

Soil, etc.—Elm trees grow best in somewhat sheltered positions. They require rather a light soil although they need an abundance of moisture.

The common English Elm never matures its seed in Great Britain, and it is increased by means of suckers and cuttings. Seeds are sometimes imported from Southern Europe for sowing in English nurseries.

WYCH-ELM (*Ulmus montana*). Economic value.—The timber of the Wych Elm is used for carts, wagons and railway work.

Soil, etc.—Well-drained soil is desirable if a good development is wanted. Experience shews that a porous sandy loam is the best for the Wych Elm. These trees will thrive on hill sides even where there is considerable exposure.

Wych Elms are easily raised from seed. The young trees grow with great vigour almost from the start.

SYCAMORE (*Acer pseudo-platanus*). Economic value. Sycamore is used for furniture, ends of barrels and general turnery. It is also in great demand for the rollers in calico and jute mills.

Soil, etc.—The Sycamore likes a medium soil that is neither very heavy nor very light. The tree is able to flourish in quite exposed situations and it is seen at its best in the northern parts of the kingdom.

Sycamores are raised from seed and the young trees grow with great rapidity.

WILLOW (*Salix alba*, *S. fragilis*, etc.) Economic purposes.—The timber of Willow is soft but it is greatly esteemed where toughness combined with light weight is required. It is used for the linings of carts, for making packing cases, and also as the raw material for match-making and wood pulp.

Soil, etc.—Willows like plenty of moisture but they are the most accommodating of trees.

All kinds of willows are amongst the easiest trees to propagate from cuttings. They grow at a great rate when once established.

POPLAR (*Populus nigra*, *P. alba*, *P. canescens*, etc.) Economic value.—Poplar is used for the making of railway wagons, carts, etc., and for turnery, etc.

Soil, etc.—Poplars flourish best in a good moist loam. They are mostly of very rapid growth and on suitable grounds are extremely profitable.

Poplars are best raised from slips or cuttings.

BIRCH (*Betula alba*). Economic value.—Birch timber is soft and not very durable. It is used by cartwrights, turners, cabinet makers, etc.

Soil, etc.—The birch will grow in exposed places and at a considerable altitude. Birch trees grow in Scotland up to 3,000 feet, but at this elevation the timber is not of the best quality. Excellent woods may be established up to 1,500 feet. The birch grows in poor dry soil and is one of the most accommodating of trees.

ALDER (*Alnus glutinosa*). Economic value.—Alder is durable if it is kept in a damp state. Used for clog soles, staves for herring barrels and, on the continent, it is burned for charcoal.

Soil, etc.—The Alder is a moisture-loving tree, but it has latterly proved to be very accommodating. As has been indicated on an earlier page, the tree will make itself at home almost anywhere.

Alders are easily raised from seed.

HAZEL (*Corylus avellana*).—Economic value.—As coppice wood Hazel is extensively employed as hoops for barrels, withes for hurdle making, etc. Hazel grows well in conjunction with many other trees such as Oak, Chestnut, Willow, Ash, etc.

Soil, etc.—Hazel thrives on all kinds of soil but it is happiest on a moist loamy land.

Hazel can be raised from nuts, but it is a tree that is readily propagated by layers.

SCOTS PINE (*Pinus sylvestris*). Economic value.—The wood of the Scots Pine is used for innumerable purposes.

Soil, etc.—The timber of the Scots Pine varies greatly with the conditions under which the tree is grown. As a whole, the Scots Pine is one of the most accommodating of trees. It can be seen growing quite well on peaty soil and also flourishing on sand in the South of England.

The Scots Pine is readily raised from seed.

SPRUCE (*Picea excelsa*). Economic value.—Timber is next in quality to Scots Pine. The wood of the Spruce is very light and pliable but its condition depends upon the soil and situation in which it is grown.

Soil, etc.—Spruce is fairly accommodating but it grows best on somewhat light soil, even if this is of poor quality. Young Spruce trees are always in demand at Christmas time.

Spruce is propagated by seed.

DOUGLAS PINE (*Pseudotsuga douglassii*). Economic value.—The timber of the Douglas Pine is used for ship building, house building, carpentry, etc.

Soil, etc.—Thrives best in deep fresh loam and likes a sheltered position where the atmosphere is humid. Better suited to low lying tracts of land than elevated districts.

The Douglas Pine is raised from seed.

SILVER FIR (*Abies pectinata*). Economic value. The timber of the Silver Fir is used for the same purposes as Spruce.

Soil, etc.—The Silver Fir likes a deep stiff loam, and it grows best in somewhat sheltered situations.

The Silver Fir is readily raised from seed.

LARCH (*Larix europaea*). Economic value.—The timber of the Larch is the most durable of all conifers. Owing to its comparatively quick growth it is one of the most profitable of all trees to plant. Larch wood is used for a great many purposes, and it is always in demand in any district.

Soil, etc.—The Larch prefers a deep but light soil and good drainage is essential. Although the Larch will grow in elevated positions, it does not flourish at the same altitude as the Scots Pine.

Larch trees are raised from seed.

MIXED WOODS.

In conclusion, special attention may be drawn to the value of mixed woods. The length of time required for growing the largest sizes of timber is very considerable, but a much earlier return may be secured if some of the quicker growing kinds are introduced into the plantations in conjunction with the big forest trees. An additional gain is also secured in the better protection of the ground. As has been pointed out in the case of oak woods, it is desirable to screen the ground by means of young beech trees. Any combinations of trees that may be made is not entirely controlled by the state of the soil. Even more depends on the amount of light that the different kinds require for their proper growth. Trees for which a good amount of illumination is essential include Larch, Birch, Scots Pine, Poplar, Willow, Oak and Elm. In these cases it should be arranged that there is no serious overshadowing, or good results will not be secured. Trees that flourish even where the shade is considerable include Spruce, Douglas Fir, Beech, Hazel, Sweet Chestnut, and Sycamore. A few trees, such as the Ash and the Alder, although preferring a fully-lighted situation, will endure a considerable amount of shade.

 VI.—ENSILAGE.

By A. W. Oldershaw, M.B.E., B.Sc., Agricultural Organiser for East Suffolk.

PAST EXPERIENCES.

Ensilage, or the process of preservation of crops in a green state, has long been a subject of great interest to farmers. The Egyptians, we are told, hundreds of years before Christ, put grain and other crops into large stone jars, covering them as tightly as they could. Julius Cæsar, again, is stated to have made pits at convenient points along the great military roads built by him, these pits being lined with clay, filled with green forage, and then trampled on and sealed with clay, so that he had food for his horses when necessity arose. The Mexicans, also, are alleged to have made crude silos, many years ago. A good historical account of ensilage is given by Mr. H. M. Jenkins, in the "Journal of the Royal Agricultural Society." (1)* Coming to more modern times a great

* These figures refer to the papers mentioned at the end of this article.

deal of interest was taken in the subject of ensilage about thirty years ago by prominent agriculturists in various parts of Great Britain.

A report dealing with the question was issued by the Agricultural Department of the Privy Council Office in September, 1885. Agriculturists in various parts of the country replied to a series of questions and these replies are embodied in the report. An excellent summary of this report is given in the "*Bath and West Society's Journal*" for 1885—6.

It appears that there were in Great Britain at that time 1,183 silos of varying sizes. Brick, stone, concrete and slate were used for the walls of the silos, those built of the first-named materials being usually coated with cement. Wood was also used in some cases, but being perishable and difficult to render air-tight it was objected to. Earth pits were also used.

Silage was usually made in silos, but occasionally it was made in stacks above ground. Buildings of all descriptions, including barns, out-houses, and even ponds and limekilns, were successfully adapted for the purpose of silos. Meadow grass, clover, trifolium, and aftermath were generally preferred for silage crops, but oats, green barley and wheat, maize, buckwheat, sainfoin, rye and other artificial grasses, vetches, lucerne, hopbine, mangold and turnip tops, peas and beans, and various kinds of rough materials were all more or less successfully made into silage.

On the whole, the conclusions arrived at were that the cost of making silage at that time was less than that of making hay, especially when wet weather prevailed. It was generally agreed that silage was in every way a suitable food for stock, and especially for dairy cows. In combination with other foods it gave distinctly good results, from 25 to 50 lbs. silage being frequently given to cattle daily.

Mr. H. M. Jenkins in 1884 published a report on the Practice of Ensilage at Home and Abroad, and after visiting a large number of farms where silage was being made, both in this country and abroad he gave in considerable detail the methods generally in vogue.

In the summer of 1885 experiments were commenced by the Bath and West and Southern Counties Society on the Ashton Court Estate. A very carefully-prepared scheme was adopted; particulars of this are given in the "*Bath and West Society's Journal*" for 1886—7. The general results of these experiments showed that there was a considerable loss of nutritive material, especially of non-nitrogenous substances, in converting grass into silage, and that

the albuminoid constituents were more reduced when sour than when sweet silage was made.

In the *Times* of January 6th, 1887, Mr. R. W. Waithman describes his system of making silage in round stacks 15ft. in diameter. He mentions that meadow grass was used, the stacks were raised to 10 ft. in height, allowed to settle, then built up again, this process being repeated, and the whole then covered up with earth.

The result was sweet silage of excellent quality, and Mr. Waithman claimed that his experiment showed that neither costly buildings nor expensive pressing machinery were requisite to the successful production of sweet silage.

In the "Journal of the Bath and West Society" for 1886—7 a description is given, in some detail, of Johnson's stack press, an illustration of this appearing on page 35. It was mentioned that this system of making silage was less costly than building silos.

In addition to those conducted by the Bath and West Society, experiments were also carried out in England by the Royal Agricultural Society, by Lawes and Gilbert and by many private individuals. In Scotland an Ensilage Committee of the Highland and Agricultural Society was appointed. This Committee issued a report in the Transactions of that Society for 1885 giving details of experiments conducted by Mr. Colin J. Mackenzie at Portmore.

Mr. Mackenzie concluded that most forage plants can be made into silage, which material forms a suitable food for all classes of cattle and sheep. He also considered that grass crops could be conserved at a somewhat less cost than by making into hay, and that the system of Ensilage has the further advantage over hay-making that it is independent of the weather.

He pointed out that certain crops (such as white crops in Upland districts in late seasons, aftermath, etc.), can by this process be turned into good fodder, while under the existing system they are frequently damaged and sometimes lost.

He further considered that cattle and sheep thrive as well on silage as on turnips, and that, accordingly, it is possible under this system to work in many districts with less cultivation and consequently with less expense.

At the Suffolk Fat Stock Show held in 1890, prizes were given for silage, six samples being exhibited.

After this period, a series of dry seasons followed and interest in ensilage gradually died out in this country, although a few stalwarts still continued the practice. Why the others gave it up is a mystery to the writer of this article.

In America the making of silage appears to have progressed

without any set-back, and of late years the number of silos built has been very large. It is estimated that in the United States on January 1st, 1914, there were 130,303 silos, no less than 30,925 having been built in 1913.

During the past few years there has been a great revival of interest in the subject in England, especially in East Anglia. Probably from 60 to 70 modern cylindrical silos have been erected. At Ipswich Fat Stock Show, Christmas, 1916, the writer collaborated with Mr. G. P. Watkins in judging a class for silage consisting of 23 entries.

The great development of the practice in America appears to be due to the introduction of the cylindrical silo, and to the great bulk of fodder per acre produced by maize, the chief American silage plant.

ADVANTAGES OF MAKING SILAGE.

The advocates of the silage system claim—

- (1) That it produces a large bulk of valuable food at a low cost.
- (2) That there is almost a certainty of obtaining a crop.
- (3) That the crop can be ensiled in June and July, when the land is dry and the days are long.
- (4) That there is no risk of loss from early frost as with mangolds.
- (5) That the land is cleared early, and is then made ready for turnips on suitable soils. On the heavier soils mustard can be grown and ploughed in, or a bastard fallow made.

They also claim that a great saving of labour is effected throughout, as compared with roots, that more stock can be kept on the farm than when roots are grown, and that consequently more dung will be available. They lay stress upon the value of the slag applied to the tares, also to the nitrogen accumulated by that crop, and claim that under the silage system it will pay to plough up poor grass, in this way permanently increasing the home-grown food supply by increasing the area of land under tillage. (2)*

Another point in favour of silage is that it enables farmers to utilise, on a much larger scale than formerly, the very bulky tare crop. All farmers know that to make tares into good hay is a difficult, and in some seasons, an impossible task, particularly in the wetter districts of Great Britain. But the making of silage is practically independent of the weather.

The very fact of preserving green crops in a succulent state brings the feeding of animals during winter nearer to natural conditions, and for that reason is undoubtedly an advantage. It is also worthy of note that a heavy crop of oats and vetches has a distinct effect in smothering rubbish. This crop does not actually kill such weeds as couch grass or coltsfoot, but it weakens them and makes them more easily dealt with in the subsequent bastard fallow.

In Great Britain, it is usual to make silage of leguminous crops, such as vetches, lucerne, sainfoin, etc. These crops accumulate nitrogen from the air, and so enrich the field in which they are grown, and subsequently the manure heap also, in the very plant food which the poor land most suitable for silage crops so badly lacks. It is also a point of importance that these crops, being rich in albuminoids, render animals like milking cows, which require a large supply of those materials, more independent of such concentrated food as cakes and meals.

In answer to the objection raised as to the large initial cost of silos, it may be pointed out that to store hay under a hay barn also involves considerable expenditure. If no hay barn is provided then in certain seasons considerable loss may take place owing to a heavy fall of rain before there is time to thatch. Even the covering up of mangolds in clamps involves a certain annual expenditure of time and labour. Silage has the additional merit of occupying very little space per ton.

After observation of the results obtained for some years on a large number of farms in East Anglia where the silage system has been adopted, the writer has formed the opinion that the introduction of that system would be an advantage on considerable areas of land in Great Britain and Ireland. At the present time, however, the building of silos is heavily handicapped by the extreme scarcity and costliness of materials.

Whilst expressing a decided opinion in favour of the silage system, under certain conditions, the writer wishes to point out that where heavy crops of roots—30 to 40 tons per acre—can be grown regularly, it appears unlikely that ensilage possesses any decided advantage over root growing. Root growing, on such soils is a very cheap and economical way of producing food for stock. Where, however, root growing is difficult, as on the retentive clays of the Midland and Eastern Counties, or on certain poor light soils where a low rainfall prevails, the system of ensilage possesses certain decided advantages. It is a very difficult matter to get a good crop of roots on poor heavy land—a good tilth is hard to obtain—a

faulty "plant" results, consequently in many cases the crop proves disappointing.

On the other hand, even on our poorest clays, the growing of a good crop of oats and tares, or tares alone, presents no difficulty, particularly when the crop is sown in the autumn, as is usually the case.

Many of these poor clays were allowed to go down to very poor grass during the period of Agricultural depression. Some of them have been ploughed up since the war, but there still remain large areas under so-called "grass." The opinion is expressed elsewhere (3 and 4)* that the introduction of ensilage would add to the productivity of this poor heavy soil and make it possible from an economic point of view to re-convert it into arable land. The vastly greater productivity of arable as compared with grass land is now generally admitted. Not only does the arable land produce crops which can be directly consumed by human beings, but the green crops grown for animals on arable land produce a much greater weight per acre than does grass. Thus at Saxmundham, Suffolk, the writer weighed 11 tons, 15 cwt. per acre of green tares : on the same soil the average weight of a "no manure" plot on old grass was only 1 ton 16½ cwt. per acre of green grass. Even when the land was manured with 10 cwt. of basic slag, it gave only 3 tons 15½ cwt. of green grass per acre.

The opportunity of making a bastard fallow after the tares are removed is a very important point, as by this means, in a favourable season, it may be possible to clean the land and so avoid a bare fallow.

In Suffolk a number of farmers on quite easy-working land have adopted the silage system. On such land, after the tares are removed, and if the land is clean, turnips may be grown. The writer has weighed 15 tons per acre of turnips—roots and tops together—grown in this way.

During the past season Buckwheat has been grown, in at least one case, as a catch crop after a silage crop. It would appear then that the silage system is a matter for very careful consideration by Agriculturists all over this country. It has been adopted by a considerable number of farmers in East Anglia. Silos are gradually springing up in other parts of England and Scotland, and once the cost of building materials returns more nearly to the normal there seems very little doubt that ensilage will become—not perhaps so important an item in British as it is in American Agriculture—but still a valuable aid to the British Farmer in keeping his head above water and increasing the produce of his land.

METHODS ADOPTED.

Modern Ensilage practice differs from that of former times chiefly in the facts that a cylindrical silo of considerable height or depth is provided, and that a special crop, such as oats and tares, capable of a heavy yield per acre, is grown for the purpose of being stored in a silo.

Before proceeding further to study the more modern methods it would be well if the making of silage without the help of a special silo received brief consideration.

On the farm of Mr. J. C. Kieran, J.P., of Rathbrist, Co. Louth, Ireland, green grass was carted and made into a heap with a circular base. A horse walked about on the top to consolidate the material during erection, and when the heap was raised to as high a level as possible it was covered up with soil. This resulted in sweet silage, having a pleasant smell.

The method is similar to that adopted by Mr. Waithman and previously alluded to. A similar method is also described in detail in the Board of Agriculture's Leaflet No. 9 (Revised, August, 1918).

On an adjoining farm Mr. J. C. Kieran, Junr., made ensilage from meadow grass on what may be termed the "Manure Heap" or "Clamp" method. Here the loads of green grass were piled up like a manure heap on the level ground, the empty carts being drawn over the heap and the whole made as high as possible. When finished the sides and ends were trimmed off, and the whole covered up with earth. This resulted in sweet silage of excellent character.

It is doubtful, however, whether this system could be adopted in the case of oats and tares, as owing to the open nature of the tares, it appears likely that too much air would gain access, and the result would be much damaged material.

About seven years ago this "Manure Heap" method was tried on a Nottinghamshire farm, under the observation of the writer, a field of Spring wheat which failed to ripen properly being made into silage. The wheat contained a good deal of clover in the butts. The crop was made into a heap as before stated, without chaffing, the sides being pared and the whole covered with earth. The result was quite good silage in the centre of the heap but a good deal of waste on the outside, doubtless owing to the open nature of the wheat straw. Mr. C. S. Read (6)* describes how he made silage on this "Manure Heap" plan, but he states that it is better, on a dry sub-soil, to excavate the earth two or three feet deep, using the

mould thrown out to cover up the sides and top ; from my own observations I should decidedly agree with this latter recommendation.

Prof. Wrightson (7)*, in reviewing the Agricultural lessons of the eighties, states that the ensilage system as originally described was exceedingly simple and might be summed up as the burying of grass in trenches.

In an article contributed to the "Journal of the Board of Agriculture" (5)*, the writer refers to the plan adopted by Mr. F. W. D. Robinson of Roos Hall, Beccles, of making silage in old gravel pits. In this case the sides and openings of the gravel pits were roughly supported with wood, a chaff cutter was fixed on a side of the pit and the pit was then filled with chaffed green material. The whole was covered up with rough stuff and weighted down with heavy logs of wood. This method resulted in quite good silage, but there was very considerable waste at the sides and entrance to the pit. Mr. Robinson also made long maize into silage in a pit of this kind with fairly satisfactory results.

"TRENCH" SILOS.

The writer has had under observation for some time a method of making silage practised by Mr. Wm. Makens, of Colney, Norwich. Mr. Makens has a pit about 4ft. deep, 25 yards long and about 5 yards wide, which holds the produce of 50 acres of lucerne. The sides of the pit have a slight slope. This prevents access of air and allows for shrinkage of the silage. The soil is sandy. If it were clay it would be necessary to arrange for drainage. The lucerne is cut, carted to the pit without chaffing, tipped in and roughly levelled. When the pit is being filled, the first few loads are tipped in at each end, to enable the horses to draw the loads over it, as one would draw over a heap of farmyard manure. The men cart for two days and then leave it for a day and cart for two days again. Five or six acres of lucerne are carted in a day. Two men are wanted at the heap, three men put into rows in the field, two men pitch and one loads. When the lucerne in the pit is level with the surrounding ground, the empty carts go over it and, as it gets higher, horses walk about on it. Carting goes on until the heap gets about 12 ft. above the level of the ground, or as high as is possible for the horses to draw the loads up, when the sides are roughly cut and squared and the whole topped up and roofed with earth by hand like a mangold clamp. The pit when full holds sufficient to keep a hundred cows for six months. The pre-war

cost of filling was about 7s. an acre, and Mr. Makens has successfully made silage in this way for about 30 years.

In addition to the above-mentioned pit, Mr. Makens has two smaller pits, in which he has successfully made silage in this way from lucerne, sainfoin, vetches and trifolium, all unchaffed. He once had a failure, which was, in his opinion, due to carting the crop when wet.

To avoid any strong smell from the finished product, the crop should lie a day or so after carting, according to the weather. If the crop is carted very green, the smell is apt to be offensive, hence it is better to allow a short time for it to wilt.

The writer has carefully examined the silage made by this method, and found it of excellent quality. When carefully carted over and covered up there is very little waste on the sides or top of the pit. The material, being unchaffed, is fed to the cattle from racks, like hay. This method of making silage appears to be so successful, that where satisfactory drainage can be arranged for, or the soil is sandy, the erection of costly silos appears to be hardly justified, particularly at the present time when the price of materials is so high. The cost of excavating a pit of the type indicated is not great on sandy land, as the work can be done at slack times.

If a silo of this "Trench" type were made on heavy land the site would have to be carefully chosen, so that good drainage could be provided to take away all surface and underground water. Probably such a trench might be made near a deep ditch, and pipe drains arranged to take away the water. It is possible, although not certain, that it might be an improvement to put a layer of concrete on the sides and floor of the trench.

The Department of Agriculture, New South Wales (8), describes a system of making silage similar to this, but emphasises the point that the site for a pit of this kind should not be liable to surface wash, floods, or soakage, as, in such case, water gets in and spoils the silage.

In one case known to the writer an old barn had the sides strengthened and a portion of it filled with chaffed green material, the whole then being weighted with boards and slabs of concrete, with some sand. The resulting product was quite satisfactory silage.

In another case, a portion of a barn was transformed into quite a satisfactory silo, by sinking the floor, and adding extra walls. The whole when finished was 18 ft. deep, the floor, which was rectangular, being 16 ft. by 18 ft.

For the past 15 years Mr. S. T. Harwood, of Battisford Hall,

Suffolk, has made any surplus maize into silage at the end of a shed. One end of the shed is divided off by means of boards, the maize, being chaffed with an ordinary chaff-cutter, filled into the boarded end, and then weighted down with old iron, etc. The resulting product is eaten well by horses and sheep, whilst pigs will eat even the mouldy parts.

MODERN PIT SILOS.

An American Bulletin (9)* describes in considerable detail the methods adopted in making silage in deep pits. The writer has seen only one silo of this type in this country—that on the farm of Mr. H. C. Boggis, of Park Farm, Benacre, Suffolk. Mr. Boggis excavated a cylindrical hole, 12ft. deep and 18ft. in diameter in the sandy soil. Sheets of corrugated iron were then fixed round the edge for a height of 6ft., and in this way a total depth of 18ft. was obtained. The pit was not cemented in any way, but was filled with chaffed material, and good silage results, although there was a certain amount of waste on the sides. This would not be the case if the sides were cemented. The American bulletin above referred to points out that silos of this type can be constructed by farm labour at a comparatively small cost. If well made, they are permanent and safe and the cost of repair is practically negligible. These underground silos should be constructed only in soils that are firm and free from rocks and sand strata and where the water table is always below the bottom of the floor.

Silage can usually be removed more easily and more rapidly from the above-ground types of silos, but it is stated that the use of hoists renders this advantage a slight one, for practically twice as much power must be used to cut the silage and elevate it to the top of the silo, as is required to merely chaff the silage, which is all that is wanted in the case of the pit silo.

A concrete curb around the edge of the pit is recommended. This should be made before the soil in the centre of the proposed pit is taken out. The floor of the pit should be sunk in sections a few feet at a time, and cement applied to the wall as the floor is taken out. The lining of cement should, it is stated, be from 1in. to 1½ins. in thickness, and a mixture of 1 part of cement and 2 or 2½ parts of clean sharp sand is suggested as suitable. A swinging crane, windlass, pulleys and rope, are arranged over the edge of the pit to hoist the silage out. An efficient hoist greatly reduces the time and labour required to remove the silage and it should be erected before the silo is excavated, as it then serves to hoist the soil out.

A wall is erected round the edge of the pit to increase the capacity and also to prevent anything falling into the pit.

This type of silo is very highly spoken of by Mr. Harlen D. Smith (10)* in the "Country Gentlemen" of Philadelphia. Mr. Smith gives details as to construction and points out the simplicity and cheapness of this type of silo. There are many places in England where the subsoil is very dry and where there would be no fear of water accumulating in such places. Pit silos are possibly the cheapest form of silo available, except Mr. Maken's "trench" silo. There is also the advantage that no expensive elevator is necessary.

The writer wishes it to be clearly understood, however, that pit silos have not passed beyond the experimental stage in this country and that much more investigation is required before they can be recommended with confidence. Still there appears to be no very obvious reason why they should not be a success where the soil is suitable, as they are evidently quite a success in America.

Mr. Harlen D. Smith states that a pit 12 ft. diameter and 20 ft. deep would hold 58 tons; 12 ft. diameter and 34 ft. deep, 81 tons; 16 ft. diameter and 34 ft. deep, 143 tons.

In pit silos there is some danger of poisonous gases developing, particularly when the silo is partly filled with fresh silage. If a lighted lantern when lowered into the silo continues to burn, it is safe to enter. When danger is suspected the air should be thoroughly agitated.

Persons who contemplate erecting a silo on light or medium soil with good drainage would do well to carefully study the United States Department of Agriculture Bulletin above referred to (9)*, before deciding on the type to adopt.

TOWER SILOS.

During the past few years there have been quite a number—probably more than a hundred—cylindrical tower silos of the American pattern erected in Great Britain.

These silos differ from those erected in former times in that no artificial pressure is used, the weight of the over-lying masses of silage providing sufficient pressure.

They are usually a considerable height, from 25 to 40 ft., and from 12 to 20 ft. in diameter. The materials used in their construction are concrete, brick or wood.

CYLINDRICAL CONCRETE SILOS.

The writer has had an opportunity of frequently inspecting a number of concrete silos in Suffolk.



A concrete Tower Silo erected in Suffolk.

The Society is indebted to the Board of Agriculture for the loan of a block from which this figure was prepared



A wooden stave Silo erected in East Anglia.
The Society is indebted to the Board of Agriculture for the loan
of the block from which this figure was prepared



So far as he is aware, the first cylindrical concrete silo erected in that County was on the farm of Mr. F. W. D. Robinson, of Roos Hall, Beccles. This was 25 ft. internal diameter, and 36 ft. in height, and proved rather too large for ordinary purposes. In feeding silage, it is found necessary to remove about $1\frac{1}{2}$ ins. to 2 ins. thickness daily, or the material moulds. Hence it is better to have a silo with a fairly small diameter—probably 16 ft. is large enough on most farms.

The Suffolk concrete silos were built on the general lines advocated by Mr. Digby Hussey De Burgh, of Drumkeen, Pallas Green, Co. Limerick (11).^{*} Elsewhere (3)^{*} the writer has given in detail particulars relating to a concrete silo, erected on the farm of Mr. Sam. Balls, Carlton Colville Hall, Lowestoft, and it is not necessary to repeat those details. It may be stated, however, that this silo is cylindrical in shape, with an internal diameter of 15ft., it is 25ft. in height above ground and is continued 5 ft. below ground. The walls are 1 ft. thick and are reinforced with old iron. The materials used included 45 loads of gravel, 10 loads of sharp sand, and 12 tons of cement. The circular mould used was made by a local carpenter of creosoted wood, and cost £7 10s. 0d. In this silo, as in all tower silos, whether wood, brick, or concrete, a door is provided at the top through which the silo is filled. A number of smaller doors are arranged, one above the other up the silo, serving to facilitate the removal of the silage as it is required for feeding. A ladder is fixed to enable workmen to ascend and descend. The building was erected in 1915 and cost £112, exclusive of carting.

In the "Journal of the Board of Agriculture," February, 1917, the writer of this article gives further details regarding the construction of five other concrete silos, recently built in Suffolk.

A somewhat similar silo to these was erected more recently by Mr. John Postans, of Hadleigh, Suffolk. It is 14 ft. internal diameter and 37 ft. high, the concrete being 1 ft. thick. The cost of this silo was £148.

Mr. Robinson, of Woolpit, Bury St. Edmunds, erected a concrete silo with walls 9 ins. thick. In this case the work was done by a concrete specialist, who reinforced the concrete with iron rods, thus rendering the greater thickness of walls unnecessary. This silo was erected three years ago, and cost £150.

In 1918 the Food Production Department of the Board of Agriculture (72, Victoria Street, London, S.W.1.) being of opinion that the silage system is likely to increase home-grown food production, issued a scheme with a view to helping agriculturists

desirous of building concrete or brick silos on their own farms ; drawings of standard types of silos are given by the Department.

The silos recommended by the Food Production Department differ from the silos erected in Suffolk in that the green material is put into them by means of an ordinary farm elevator and is not chaffed. This represents a considerable reduction in expense, as the cost of chaffing and provision of chaff-cutter is avoided.

Many farmers, however, prefer to use chaffed material, especially in the case of tares, which frequently attain a considerable length. It appears probable also that unchaffed material would occupy more space than chaffed, and would require more trampling.

BRICK SILOS.

The Food Production Department are prepared to give advice on the building of brick silos. The writer is indebted to Mr. J. G. Stewart, M.A., of the Board of Agriculture, for calling his attention to a brick silo erected by Mr. T. D. Heaver, of Kiln Farm, Albury, Ware, Essex. This silo resembles those recommended by the Food Production Department in that the material is put in unchaffed. Mr. Heaver says that he would sooner get unchaffed than chaffed material out of the silo. Mr. Heaver and Mr. A. R. Robertson, of the Irish Department of Agriculture (who subsequently inspected this silo) have supplied the following information regarding it.

It is built of 14 in. brick walls, reinforced with hoopiron, is 28 ft. high and 20 ft. in diameter, and it cost £200. The roof is covered with weather boarding and there is a Boyle's ventilator on the top. The inside of the silo has a coating of cement containing a proportion of "Pudlo" and is polished perfectly smooth with a steel trowel.

There are a number of silos in Hertfordshire built of brick, the most popular size being about 30ft. high and from 15 to 20 ft. in diameter. Some of these were built at a cost of under £120 but no doubt would cost much more now.

WOODEN SILOS.

During the past few years a number of wooden stave silos have been erected in the Eastern Counties, two firms of timber merchants, one at Wisbech and one at Norwich, having specialised in the erection of these structures. They are usually 16 ft. in diameter and 32 ft. high, the foundation being of concrete. A wooden stave silo is somewhat like a hugh barrel, except that the sides are perpendicular instead of bulging. The staves are held together by iron

bands bound round the whole structure. These bands can be tightened when required. The silo is kept in place by three or more wire cables, each attached to posts in the ground, several yards away from the foot of the silo. Doors are arranged in the side of the silo, one above the other, from the ground to the roof, to allow of the silage being removed. The workmen climb up the silo by means of bars across the doors. In some cases a wooden chute is arranged to guide the silage down to the ground.

The cost of this type of silo was about £100 before the War. It had risen to £160 in January, 1917, and during the last two years of the war the wood required to construct these silos was very difficult to obtain at any price. It appears that these silos can be removed, and hence are suitable for erection by a tenant farmer. Several silos of this type were erected 6 or 7 years ago in this country and, as far as the writer is aware, none of them have been blown down, or shown very evident signs of decay as yet. In America, however, it is stated (12)* that "the life of the stave silo varies from 5 to 20 years, according to the quality of the material used, the method of construction, and the care and attention given to the silo."

In America, as has been noticed before, there has been a very large development of ensilage practice, and there exists in that country a very extensive literature relating to silage. Many of the American publications give much valuable information on the subject of building silos, and a short reference to some of them may not be out of place here.

Thus it is stated by the United States Department of Agriculture (13)* that many failures in building silos have been due to faulty foundations, and that the doors are also a source of weakness. For concrete silos a wall 6 ins. thick is recommended. This is the same thickness as the walls of the Food Production Department's silos.

Most of the Suffolk silos are 1 ft. thickness of concrete but very few of them have been reinforced with steel rods, as recommended by concrete experts. In most cases, old iron which happened to be available has been used for purposes of reinforcement. For building the walls two circular forms are needed, one inside the other with a 6 in. or 1 ft. space between them into which the concrete is poured. The forms are 3 ft. high, and those of galvanized iron are recommended. It is very important to use clean sand, free from clay or vegetable matter, in making the concrete.

The gravel used should preferably be made up of particles from $\frac{1}{4}$ in. to 1 in. diameter. The inside surface of the silo should be washed with cement.

Many details are given in this bulletin which are extremely useful to any farmer who wishes to build his own silo and who is not an expert in erecting concrete structures.

The Department of Agriculture, British Columbia, publishes a very useful Bulletin (14)* on the construction of silos. It is therein pointed out that it is essential :—

- (1) That the silo be made air-tight.
- (2) That it be made deep enough.
- (3) That the walls be made perpendicular.
- (4) That it shall stand on solid ground (on account of the high weight of silo and contents when full).
- (5) That the walls be rigid and strong.

A layer of 2 in. thickness of silage should be removed daily, or the silage will get mouldy ; hence it is most important not to have the silo of too large a diameter for one's herd of cattle.

Mr. J. H. Grisdale (B. Agr.) Director of the Canadian Experimental Farms also states (15)* that it is essential that proper drainage be provided at the bottom of the silo. Some of the Suffolk silos, however, have no drainage provided, and the writer has not heard of any silage being spoilt from this cause. Mr. Grisdale further strongly advocates the washing of concrete silos with cement, both inside and out.

From his own observations the writer of this article is quite convinced that a concrete silo should have a very smooth inside surface. If this is not provided the silage does not sink down from the sides properly, the air gets in and mould results.

In another bulletin (16)* Mr. Grisdale gives detailed instructions as to the building of wooden silos. Valuable information regarding the construction of wooden and concrete silos and the feeding of silage is also given by Messrs. W. A. Barr and R. R. Graves in a pamphlet (17)* issued by the Oregon Agricultural College, U.S.A. Other publications well worthy of study are "Silage and Silo Construction" (18)* by C. H. Hinman, Kansas State Agricultural College, Manhattan, Kansas, and "Silos and Silage" (19)* published by the Georgia Experiment Station.

Valuable information regarding the construction of concrete silos is also given in booklets issued by the Portland Cement Manufacturers of both this country and America (20 and 21)* and in "Modern Silage Methods" (22)* published by the Silver Manufacturing Company, 149, Queen Victoria Street, London, E.C.

WOODEN, CONCRETE, AND BRICK SILOS COMPARED.

As has been previously noted, wooden silos can be removed and hence are convenient for erection by tenant farmers. Mr. G. Jaques, who is a great advocate of silage, has removed his wooden silos from Tivetshall, Norfolk, where he formerly farmed, to Westerfield, Suffolk. At the time of writing (Nov., 1918,) he has not yet re-erected them, but there appear to be no obstacles in the way of his doing so, and the writer is informed that he proposes to re-erect them in time for the 1919 silage crop.

There can be very little doubt, however, that concrete and brick silos if skilfully erected will prove much more durable than wooden ones.

Colorado Agricultural College states (12)* "There have been failures in all types of silos, but it is safe to say that the percentage of failures is less in concrete than in most other types."

None of the silos, either wooden or concrete, known to the writer, can be described as failures, but they have not been erected long enough to really test their durability. Provided the silos are well-constructed, there appears, so far as the writer's experience goes, to be no difference in the quality of the silage made, provided similar materials are put into the silo.

COST.

At the present time, owing to War conditions, it is difficult to obtain the timber necessary to erect wooden silos.

Concrete and brick silos, like all other buildings, can only be erected at a very high cost just at present. Pit silos possess the great advantage of cheapness, but are apparently only suited for light soils or where there is good drainage. Much further information is required as regards the suitability of pit silos to British conditions.

Silos of the trench type, as made by Mr. Makens, possess the advantage of extreme cheapness. Good drainage is, however, absolutely essential.

Before land owners or farmers decide upon the type of silo to erect, a study of a few of the American bulletins would appear to be very desirable. Some of these give elaborate details of construction which are beyond the scope of this article, but which cannot fail to be of great use to those actually erecting the silo. Most of the publications referred to can be borrowed free of charge from the Board of Agriculture's Library (3, St. James Square, London).

SITE OF SILO.

If tower silos are erected they should be in such a position that the chute empties directly into the mixing house, for silage is heavy and it is desirable not to carry it further than is absolutely necessary. An arrangement of this kind has been adopted in several instances in East Anglia. At Hawkesbury Agricultural College, New Zealand, they have four silos, side by side, in a square, which empty into troughs, on rails, and these go direct to the cattle. The same cutter and elevator, permanently placed, does for all four silos.

TEMPERATURE IN MAKING SILAGE.

A considerable amount of attention was, in former years, devoted to the question of the temperature reached by the green materials, whilst making silage. Modern silos, however, have apparently overcome all difficulties in connection with temperature. The material gets warm in the silos, but the writer has not come across any case in which too high a temperature was reached, although it is quite possible, and indeed probable, that, if partly dried material were put into a silo, it would over-heat, as is the case with hay stacks which are made of insufficiently cured hay.

In the case of very succulent materials like vetches, it is no harm, in fact probably an advantage, to allow them to remain in the sun for 24 hours after cutting. Other crops, such as lucerne, clover, meadow hay, etc., are probably quite as well placed in the silos as soon as cut. Green materials may be placed in the silo when soaking wet, but so far as the experience of the writer goes, this results in very sour silage and it also involves handling a considerable weight of unnecessary water.

Speaking generally, temperature in the modern silo may be said to look after itself, given reasonable precautions.

SIZE OF SILO.

It is very important, as previously noted, not to build a silo too large for one's herd, as unless the silage is regularly removed waste occurs on the top. For the winter feeding season it is safer to calculate upon removing 2 inches daily rather than a smaller amount.

AREA OF CROP REQUIRED TO FILL THE SILO.

The following table, given by the Food Production Department of the English Board of Agriculture gives a useful indication of the area of crop required to fill a silo.

Crop for Silage.	Acres of crop required to fill a Silo 15 ft. diameter and 30ft. high, holding about 100 tons of Silage and suitable for a herd of 25 cows.	Acres of crop required to fill a silo 12 ft. diameter and 24 ft. high, holding about 50 tons of Silage and suitable for a herd of 12 cows.
Maize	6	3
Oats and Vetches	9½	4½
Lucerne (2 cuts)	9½	4½
Red Clover and Ryegrass..	13	6½
Red Clover	15	7½
Meadow Grass	17	8½
Sainfoin	12	6

FILLING THE TOWER SILO.

Most East Anglian farmers fill the silo by means of a combined chaffer and blower of American make (The Ohio). A strong blast conveys the chaffed material up the tube, which is about a foot in diameter.

The combined chaffer and blower is driven by an ordinary traction engine. A number of farmers, however, have by various contrivances utilised apparatus, which they had already available, for filling the silo.

Thus Mr. E. Fred Gooding, of Winesham, uses a Bentall Chaff cutter (3 knives) placed on a floor 9 ft. above the ground, driven by his oil engine (9B. H.P.) Pieces of iron, like wings, are attached to the chaff knife to make it clear itself. The chaffed green material is elevated into the silo by an endless chain elevator, to which cups are attached. This apparatus was home-made. An elevator of somewhat similar type is used by Mr. H. C. Boggis, of Benaere, Suffolk. This elevator has slats of wood, instead of cups, to carry the chaffed material up. A Maynard chaff cutter chaffs the material which is carried directly into the silo by the elevator. The whole apparatus is driven by an Overtime Tractor. This was seen at work by the writer and appeared to answer admirably.

In another case, that of Mr. J. Postans, of Benton End, Hadleigh, Suffolk, a Maynard chaff-cutter is utilised, and has been fitted up with a fan, blower, and tube at a cost of £25. The whole is driven by a 6 H.P. Engine, and Mr. Postans maintains that the Maynard type of chaff cutter uses much less power than the Ohio type of cutter.

The Food Production Department of the Board of Agriculture and Mr. T. D. Heaver, of Kiln Farm, Albury, Ware, agree that

chaffing is unnecessary, and advocate the use of the ordinary straw elevator, a specially wide door being made at the top of the silo. To fill a silo 30 ft. high would need the use of an elevator rather higher than most of those which commonly travel round with threshing machines in Suffolk and the Midland Counties. Many of the large farmers, however, have elevators which could be used for this purpose.

If this method of putting unchaffed material into the silo proves successful it will mean a distinct saving in power.

Many ordinary farm elevators can be driven by horse power, or by a small petrol engine, so that if the green material were not chaffed, a steam engine would be unnecessary.

In this connection it is interesting to note that the United States Department of Agriculture (24)* states that clover may be placed in silos without chaffing. Opinions differ amongst practical men as to the desirability of chaffing not only silage, but also hay and straw. Some advocate chaffing as preventing waste and rendering mixing of foods more easy, whilst others prefer to use fodder long, as being nearer to a state of nature. There can be no doubt that chaffed material packs tighter, and that with long material extra treading in the silo would be desirable.

When filling the silo with chaffed material a fairly large staff of men is required. One man is wanted for part of a day to cut the crop, two men for pitching, three men for driving, loading and unloading, two men to feed the chaffer, one man treading in the silo and distributing, one man driving engine and one man providing coal and water for the engine.

In addition to this when a heavy crop of tares is being cut, three or four men are required to pull away the crop from the machine, whilst if a light crop is being dealt with two or three men or women are wanted to cock the green stuff. The operation of cutting a heavy crop of tares is very troublesome. Some farmers in East Anglia have found the grain lifters, used to lift up laid corn in front of the binder, very useful for fastening upon the grass mower and lifting the tares off the ground in front of the knives.

But even this does not solve the problem of parting the cut portion of the crop from the uncut.

In a heavy crop this requires three or four men or even more. There can be no doubt that, if tares for silage become a more common crop, an attachment to fit on to the grass mower to perform the work of separating the cut from the uncut crop will be required.

The cost of the various operations of cutting and filling was investigated by Mr. A. Amos, M.A., and the writer in 1915, and

the results of the investigation were published in the "Journal of the Board of Agriculture" (25)* but the cost at the present time would be much higher than three years ago.

The ordinary farm carts used in England are rather high to pitch green material on to, and it occurs to the writer that the hay bogies used in Scotland and Ireland would be much more suitable for bringing home heavy green fodder.

In America low waggons with platforms quite near the ground are used.

DANGER OF SUFFOCATION.

Leaflet No. 9 of the Board of Agriculture (26)* points out that there is a certain amount of danger of suffocation to anyone entering a silo for two or three weeks after filling, owing to the presence of carbon dioxide gas. This danger may, however, be removed by leaving open the doors of the silo at the level of the silage. There is no danger after heating has ceased.

COVERING UP OF CONTENTS OF THE SILO WHEN FILLED.

Unless the green material is covered up some waste occurs on the top. Many East Anglian farmers cover up with waste materials, nettles, etc., or with chaff. Others again use sand for this purpose very successfully, but it is rather heavy to haul to the top of the silo. The method sometimes advocated, of sowing oats on the top, has not been a great success in the cases which have come under my notice.

MOST SUITABLE CROPS FOR SILAGE.

Under the conditions prevailing in most parts of England, it appears probable that mixtures of winter oats and tares, or winter tares alone, are likely to give a heavier weight of green material per acre than any other crop except maize. Where the land is good it will be an advantage to include some oats in the mixture; where it is very poor, probably tares alone will give a heavier crop, but will be more difficult to cut.

At present, owing to the high price of seed tares, the seeding of the crop is very expensive, and farmers situated in a fairly dry district would be well advised to save some seed themselves.

As a rule, a mixture of two bushels of tares and 1 bushel of oats will be found suitable. A few beans, say $\frac{1}{2}$ a bushel per acre, may, with advantage, be substituted for $\frac{1}{2}$ a bushel of the tares, as they help to hold the crop up. The weight of green crop obtained varies from 8 to 14 tons per acre under ordinary conditions (25).*

It is quite a good plan to plough in the beans shallow, when

ploughing the stubbles. This gives them a start of the tares, and renders them less likely to be smothered. The tares and oats are drilled a week or so later.

The crop may be manured with 4 or 5 cwt. of Basic Slag on heavy land, or 2 or 3 cwt. of Superphosphate, and 2 cwt. Kainit (when available)—or its equivalent in some other potash manure—on lighter land.

In the moister and cooler districts of England, spring oats and tares will prove very suitable, but, as a rule, in the drier and warmer counties these prove less reliable and give a smaller yield than the winter sown crop. This is particularly the case on stiff clays which give uncertain results when sown with any spring crop.

A mixture of winter oats and tares is usually fit to cut for silage at the end of June or the beginning of July in East Anglia. At this time the tares are just beginning to form seed. Some authorities recommend their being allowed to stand a little later, and it is noteworthy that the American experts all seem agreed that maize, grown under American conditions, ought to become fairly mature. It seems probable to the writer that a mixture of oats and tares, if allowed to become too ripe, will also become more fibrous and indigestible. It often happens, also, that the crop will stand up fairly well till a certain point, when a heavy storm lays it flat. A heavy crop of oats and tares is a difficult one to cut, and a farmer may very well be tempted to cut his crop when it is somewhat immature if it is standing up fairly well. In one case which came under my observation where this was done, a rather considerable volume of liquid oozed out of the doors of the silo, and this must have involved some waste. If the weather were good, however, this difficulty could be surmounted by allowing the crop to remain in the sun for a day, after cutting.

Lucerne, in those districts where it will grow well, is a most valuable crop for ensilage purposes. In some respects it is superior to oats and tares. There is not the annual and heavy expense of seeding. Lucerne is also quite easily cut, whilst, as before mentioned, cutting a heavy crop of tares is a difficult and costly process.

In suitable localities lucerne gives three crops per annum. Elsewhere (27)* the writer has expressed the opinion, from a study of weighings made by him, that, on poor soils and with similar manurial treatment, lucerne will give more than twice as much fodder per acre as will grass.

Clover, and Clover and Ryegrass or "seeds," will make excellent silage but, as a general rule, it will be preferable to make the first cut of these crops into hay.

The second crop of clover which it is often difficult to make into hay, owing to the uncertain weather and short days prevailing in the latter part of the summer, may often be made into silage with advantage.

Sainfoin is a suitable crop for ensilage purposes, although it has not been very much used for that purpose up to the present in this country.

Mr. W. Biddell (29)* mentions having made sainfoin into silage in 1885.

Crimson Clover, *Trifolium*, trefoil and other crops of that type may also be used for ensilage purposes.

Meadow grass makes excellent silage and is a suitable material to use in the moister parts of Great Britain and Ireland where the making of hay is a difficult process.

In the drier districts it is usually better made into hay. The weight of green grass obtained per acre will compare unfavourably with the weight of green material obtained from tares or lucerne.

Green maize is grown in the Eastern and Southern parts of England for feeding of cattle in September and October. A very heavy weight of green stuff per acre is obtained—the writer has weighed 25 tons per acre. Maize is the principal silage crop in the United States and Canada.

In Suffolk I have known a large number of cases where maize has been successfully made into silage, both in a cylindrical silo and also at the end of a cart shed. The resulting product is eaten with zest by all classes of farm stock. When surplus maize, which would otherwise be wasted, is available it is quite a good plan to make it into silage. Several Suffolk Farmers, particularly on light land, where maize does exceptionally well, grow it for this purpose. There can be no doubt, however, that, in this country, maize does not become sufficiently mature to make silage in the most economical way.

Mr. K. J. J. Mackenzie, M.A. (30)* makes the excellent suggestion that it ought to be worth spending time and money in search of varieties that would be suitable for ensilage purposes. In Suffolk when maize is made into silage in the ordinary cylindrical silo, considerable quantities of liquid ooze out at the bottom of the silo, and no doubt a good deal of waste occurs in this way. Probably some of this waste could be prevented if dry straw were mixed with the maize when chaffing. This should absorb some of the liquid. Partially dried second crop of clover might also be used for the purpose.

COMPOSITION OF SILAGE.

The following analyses of silage produced under modern conditions have been made by Mr. G. S. Robertson, M.Sc., and are published by his kind permission.

These samples were of silage produced as follows :—

- (a) Made in a cylindrical silo on the farm of H. Fiske, Esq., Bramford, Ipswich.
- (b) Made in a cylindrical silo on the farm of C. C. Smith, Esq., Walton Hall, Felixstowe.
- (c) Made in a gravel pit on the farm of F. W. D. Robinson, Esq., Roos Hall, Beccles, Suffolk.
- (d) Made in a cylindrical silo on the farm of F. W. D. Robinson, Esq., Roos Hall, Beccles, Suffolk.

When filling this silo the weather was exceptionally wet, but the work went on as long as it was sufficiently fine to enable the men to work out of doors.

- (e) Made in a cylindrical silo on the farm of Fred Smith, Esq., Woodbridge, Suffolk.
- (f) Made in a cart shed on the farm of S. T. Harwood, Esq., Battisford Hall, Needham Market.
- (g) Made in a cylindrical silo on the farm of F. W. D. Robinson, Esq., Roos Hall, Beccles.
- (h) Made in a cylindrical silo on the farm of S. Balls, Esq., Carlton Colville, Lowestoft. The moisture in this sample is low, and this accounts for the comparatively high amounts of the other constituents.
- (i) Made in a cylindrical silo on the farm of J. Postans, Esq., Hadleigh, Suffolk.
- (j) Made in a " trench " silo on the farm of William Makens, Esq., Colney, Norwich.
- (k) Made in a " trench " silo on the farm of William Makens, Esq., Colney, Norwich.

The difference in composition of the above samples is undoubtedly in the main due to the different materials with which the silos were filled and to the percentage of moisture present.

Annett and Russell (31)* give a number of analyses of British grown maize and maize silage, which are also of much interest.

[illegible]

CHANGES AND LOSSES TAKING PLACE IN THE MANUFACTURE OF
SILAGE.

It is not within the scope of this article to discuss in detail the chemical and other changes taking place in the manufacture of silage under modern conditions. It may be mentioned however, that Messrs. Annett & Russell investigated the subject in the case of British-grown maize (31 and 32).^{*} They found that in making silage the fibre is practically unaltered in amount, the nitrogen-free extract suffers most loss, the sugar disappearing almost entirely, while the protein also suffers considerably.

The chemical changes involved in making silage are also discussed by Dox & Plaisance (33)^{*} and the conclusion arrived at is that the fundamental chemical changes to which silage owes its keeping properties are the conversion of the sugar present in the juice of the fresh plant into acids, which prevent the growth of putrifactive bacteria, and into carbon dioxide, which expels the atmospheric oxygen and prevents the growth of mould.

Dr. Russell (32)^{*} concludes that the changes occurring in the process of ensilage are due to three agents:—the living plant cell, the enzymes or unorganised ferments and the micro-organisms.

The question of the loss of food material which takes place in a modern silo is one of great practical importance to farmers in this country, and the subject urgently requires investigation in the case of the important British silage crops, such as oats and tares, lucerne, etc.

Messrs. Annett & Russell (31)^{*} found that, in the case of maize grown in this country, more than one third of the dry matter is lost. It by no means follows, however, that this high figure would apply in the case of silage crops really suitable for British conditions.

As previously noted, maize does not mature sufficiently in this country in an average season to make it a really first class crop for ensilage. It is too watery, and the process is wasteful.

In America, according to Prof. Woll (34),^{*} in modern well-built deep silos, the loss of nutriment in making silage should not exceed 10% in the ensilage of maize.

In experiments conducted by the University of Wisconsin (39),^{*} the total loss of non-volatile matter from all layers in the silo, including the dry matter in the spoiled silage, was 6.38%. It is pointed out that the losses at the top are chiefly due to diffusion of air downwards and to slow consumption. Admission of air anywhere leads to loss.

As has been previously noted, the methods of ensilage practiced in 1885, when experiments were conducted by the Bath and West Society, involved considerable losses of food material. Modern methods of ensilage undoubtedly involve smaller losses.

A point of great interest to the British farmer is how the losses incurred in making silage compare with those incurred in making hay. In this country, in certain seasons, very large quantities of hay are absolutely spoilt. So far as the writer is aware, no figures are available as to the loss, either chemical or otherwise, which takes place in making hay, over a series of years, but taking all kinds of hay over the whole of England, it might be held with a considerable show of reason that, on an average, one fifth of the total nutritive matter in the hay made is lost owing to bad weather, loss of leaf, etc.

In the case of such succulent materials as tares, this estimate of loss would probably be exceeded. Every farmer knows that good tare hay can only be made in really first class weather.

It appears probable, therefore, if the American figure of 10% of loss applies to crops such as oats and tares, which are really suited for silage in this country, that the average losses involved in making hay are as great, if not greater, than those involved in making silage. In the case of tares, they will probably be greater.

SILAGE AS A FOOD FOR STOCK.

The considerable amount of experience of feeding silage made under modern conditions, gained by East Anglian and other farmers during the past few years, renders the suitability of silage as a food for most classes of stock no longer a matter of doubt.

The writer has probably 60 to 70 farming friends who have silos and has heard of no single case among them in which the feeding of silage has given other than satisfactory results.

MILKING COWS.

Probably silage has been used more as a food for milking cows than for any other purpose.

Several members of the East Anglian Milk Recording Society have regularly fed their cows with silage during the past few years. The herds of these gentlemen have been periodically visited by a recorder who has not found any offensive odour in the milk.

The milk produced has also been regularly tested for fat and has not proved abnormal in any way. Silage has also proved an economical milk producer—thus the herd which produced milk at

the lowest cost, amongst members of the East Anglian Milk Recording Society in the winter of 1916—17, was partly fed up on silage.

This herd, consisting of pedigree Holstein cows, received a daily ration of 37 lbs. mangolds, 50 lbs. silage, $2\frac{1}{2}$ lbs. dried grains, 2 lbs. ground nut cake and 2 lbs. ground oats. The cows gave an average of 3 gallons of milk daily. In this herd the concentrated food allowance was systematically varied according to the milk each cow was giving. (36).*

Early in 1916, a comparison was instituted between silage versus roots and straw, as food for cows (37).* The experiment was conducted by the writer on a farm occupied by Mr. C. C. Smith, J.P., of Walton Hall, Felixstowe, Suffolk. In this experiment the silage-fed cows received daily, 60 lbs. silage, 4 lbs. dried grains, 2 lbs. ground nut cake, and 7 lbs. chaffed oat straw, whilst the root-fed cows received 60 lbs. of mangolds and 7 lbs. of chaffed oat straw instead of the silage, the other foods being exactly the same.

After four weeks of experiment, the foods were changed over, the silage cows receiving roots and the cows previously fed upon roots receiving silage. At the close of the experiment it was found that six cows fed on the daily ration of 60 lbs. of silage, together with concentrated foods and chaff, gave approximately the same quantity of milk as six cows fed upon a daily ration of 60 lbs. of mangolds and 7 lbs. of chaff together with the same quantity of concentrated food and additional chaff as that given to the silage cows.

As the rations were identical in every other respect, it may be taken that 60 lbs. of silage gave approximately the same results as 60 lbs. of mangolds and 7 lbs. of chaff.

The late Mr. John Speir gives (38)* an account of an experiment which he conducted with silage versus hay, as a food for milking cows. He concluded that, for home use, grass may either be made into hay or silage, without any material gain to either system, if there be suitable weather in each case.

Mr. George Jaques, who is a great advocate of silage, furnishes (2)* an account of his experiences in giving that material to Red Poll Cows. He fed a daily ration of 60 lbs. silage, 24 lbs. turnips and 1.6 lbs. maize gluten to 17 Red Poll cows during the autumn of 1915, and produced milk at a very cheap rate.

Mr. Digby Hussey de Burgh informs the writer that he has obtained excellent results in Ireland in giving silage to milking cows and young stock.

In order to avoid all chance of any odour of silage getting into the milk, it might be well, as far as possible, to give the silage just after, rather than just before, milking.

OTHER HORNED STOCK.

A large number of store cattle have been wintered on silage alone from time to time at Roos Hall, Beccles. Mr. Jacques also speaks of wintering yearlings on 40 lbs. of silage per head with only water in addition. He states that beef cattle, fed on similar lines to milking cows, are reported to be of excellent quality. At Woolpit, near Bury St. Edmunds, Mr. Robinson has had young stock do well on roots, ensilage and chaff, whilst in Ireland Mr. D. H. de Burgh feeds calves on silage, hay and crushed flax seed.

Mr. Colin J. Mackenzie (39)* gives an account of an experiment with store cattle, in which 28 lbs. of clover and rye grass silage, with cake was contrasted with 30 lbs. Aberdeen Yellow Turnips and 14 lbs. of straw, also with cake. The silage-fed animals gave rather better results and when subsequently killed had an average carcase weight of 2 st., 11 lbs. more than the root-fed animals. Mr. H. C. Boggis, of Benacre, Suffolk, in 1916, fed 28 fattening bullocks on silage ad lib, chaff and cake, 2 lbs. gradually increased to 4 lbs. daily. No roots were used except for the first few days. The bullocks made very good meat and weighed well when slaughtered.

FOR HORSES, SHEEP AND PIGS.

Silage has not been given very largely to these animals in East Anglia, silos as a rule having been erected by dairy farmers for their cows.

Mr. S. T. Harwood, Battisford Hall, Needham Market, Suffolk, however, has fed horses and sheep with maize silage, whilst he has found pigs eat even the mouldy parts with avidity. Mr. H. C. Boggis of Benacre, Suffolk, has fed both maize and vetch silage to horses and sheep and has found it an excellent food for these animals. In 1916-17 his flock of breeding ewes was fed largely upon silage and did well. The horses received a daily ration of one third of a bushel of silage. Mr. F. W. Barker, of Rickingham, Suffolk, has fed silage to pigs, in place of roots. Miss Gillett, of Walpole, Suffolk, has fed silage to horses, successfully, up to 30 lbs. daily. She, however, prefers clover silage for this purpose, and considers it very important that it should not be in any way mouldy, especially for brood mares. This is confirmed by American experience. She has also fed silage to poultry, allowing 3 bushels daily, for 1,600 birds.

Georgia Experiment Station (19)* states that the feeding of silage to swine has not been a complete success, as it is too bulky. Miss Gillett has fed silage to swine, with not very satisfactory results.

The amount of experimental work which has been done in feeding animals with silage in Great Britain and Ireland is very limited, and much more work is required.

There exists, however, a sufficient amount of experimental and farming experience to prove that silage is quite a suitable food for all classes of farm animals when given in moderation.

The quantities most suitable to be given to the various classes of stock have not been sufficiently tested. In all probability, however, from 30 to 50 lbs. is a suitable quantity to be given daily to a milking cow or a full-grown bullock.

American experience indicates 30 to 40 lbs. for milking cows, 25 to 35 lbs. for fattening cattle, 15 to 20 lbs. (not more) for horses, and 5 lbs. for sheep (13).*

The Board of Agriculture's Leaflet No. 9 makes the following suggestions :—

“ For cows no hard and fast rules can be laid down, but the two following rations are suggested for average dairy cows weighing about 10 cwt. and yielding 2 gallons of milk :—

Ration 1.—Oat and tare silage, 20 lbs. ; mangolds, 56 lbs. ; straw chaff, 8 lbs. ; bran, 3 lbs. ; cake and meal, 5 lbs.

Ration II. —Oat and tare silage, 50 lbs. ; meadow hay, 7 lbs. ; cake and meal, 5 lbs.

For fattening cattle between $2\frac{1}{2}$ and 3 years old a ration containing 28 lbs. oat and tare silage, 84 lbs. mangolds, 10 lbs. oat straw, and 4 lbs. mixed linseed and cocoa-nut cake, has given good results.

For Store cattle, about 15 months old, a ration containing about 35 lbs. oat and tare silage, 8 lbs. straw chaff, 2 lbs. mixed cake, has proved successful and kept the stock growing well.”

If all the roots are replaced by silage, it will be necessary to supply the cattle with water.

The number of available analyses of silage made under British conditions in modern silos is very limited. It would appear, however, as might be expected from its origin, that silage made from oats and vetches, lucerne, or similar materials, more nearly resembles pasture grass, or a green crop, in composition, than it does any other farm material. It also resembles hay, except that the amount of dry matter present in hay is nearly three times that in silage. It differs widely from roots in composition, it contains

much more dry matter, more fibre and albuminoids, but it lacks the extremely digestible sugar, which renders roots so valuable a farm food.

The following analyses form a basis for comparison :—

Moisture.	Oat and Tare Silage, prob- ably about an average sample.	Pasture grass. (41)	Mangolds. (41)	Meadow Hay. (41)
Total Dry Matter	30	20	12	86
Albuminoids ..	3½	3	1½	9
Oil	1	½	½	2½
Carbohydrates ..	12	10	9	43
Fibre	10	5	1	25

GENERAL PROSPECTS OF ENSILAGE IN GREAT BRITAIN AND IRELAND.

The great interest at present taken in Ensilage seems likely to be permanent. It is founded on the sound principle that green crops grown on arable land produce much more green food per acre than does grass land, hence more stock can be kept on the same farm. This means a higher standard of productivity. It is not likely that silage will replace roots on good root growing land, and in a good root growing climate. But, where roots are difficult to grow, silage possesses many advantages. Oats and tares are a very easy crop to grow; they will grow on poor land and do not require much manure—a dressing of basic slag or superphosphate being all that is wanted, as a rule.

Lucerne, in districts which suit it, requires very little manure and very little labour once it is sown. Sometimes it is horse-hoed, but the practice of sowing lucerne broadcast is extending. It is satisfied with a dressing of basic slag or superphosphate even on poor land. Potash, however, is necessary on light land. It is better to think of silage not as replacing roots but other farm "crops" which might well be dispensed with. If silage crops can be grown upon the thousands of acres of so-called "pasture," now producing nothing but agrostis or water grass, a weed grass, the benefit to the nation will be great. This poor rubbishy "grass" was allowed to "tumble down" during the period of Agricultural depression. It now produces perhaps 7 or 8 cwt. of hay per acre per annum, and that is all. If ensilage would render economically possible the ploughing up of this land, agriculture would have made a considerable stride forward in this Country.

Again, in certain areas in England, we have extensive stretches of sandy heath land. If mineral manures and lime or chalk were applied to this land probably much of it would grow lucerne, which could be utilised in the silo and thus lay the foundation of an ample manure heap wherewith to enrich the soil.

In the wetter districts of England, Scotland and Ireland, hay making is a difficult matter. Here silage would undoubtedly help, by rendering more certain the preservation of grass for winter fodder.

"A piece of land," says Ruskin, "which will only support 10 idle, ignorant and improvident persons, will support 30 or 40 intelligent and industrious ones."

The writer of those lines was not an agriculturist, but he understood the general principle that the productivity of the land depends largely upon the labour that is put into it and the thought that is expended upon the direction of that labour.

Probably not even the bitterest enemies of Britain would accuse us, as a whole, of being lazy or improvident. But, owing to economic reasons, our energies have been largely directed into other channels and our agriculture has been neglected. It is to be hoped that, in the future, more thought, labour and capital will be applied to the land.

The further study of ensilage on the part of those engaged in agriculture is likely to help either directly or indirectly in the production of those materials upon which we all depend for our daily bread.

In conclusion the writer wishes to express his indebtedness to the many gentlemen mentioned in this article who have assisted in various ways in furnishing the information contained therein.

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NOTE.—*Most of the American and other publications above referred to can be borrowed free of charge from the Library of the Board of Agriculture, 3, St. James's Square, London.*

VII.—NATURAL HISTORY AS A NATIONAL ASSET.

By Harold Bastin.

IN DAYS OF OLD.

There was a time when the lad who evinced a liking for natural history was too often viewed with misgivings by his parents or guardians. The thrashings which fell to the lot of young Thomas Edwards, the Scotch naturalist, who, despite innumerable obstacles in his path, became ultimately a most gifted observer, have been rendered famous by the writings of Samuel Smiles. But there were none to chronicle the sufferings which must have been endured at this period by many other boys, in all walks of life, who—blessed with an innate longing to fathom some of the mysteries of the world in which they found themselves—were subjected to great discouragement in consequence. Their thoughts were directed—not always in a gentle way—into what were termed "manly and profitable channels," which mainly represented what was regarded as most likely to prove quickly profitable from a business point of view. Of course the mentors of youth in those dark ages were convinced that they acted wisely in thus curbing any tendency on the part of their charges to escape from the rut of prescribed knowledge. Yet their strangely short-sighted policy must have stifled at birth, so to speak, many incipient men of science—

men whose activities, rightly guided and unhampered by tradition, might have added much to the health, the happiness and the prosperity of those who came after them.

A CHANGE FOR THE BETTER.

Of late years these conditions have undergone a marked change for the better. The young naturalist of to-day is at least free from active persecution and discouragement. If he will but keep his "beasties" out of the parlour, and avoid excessive damage to his apparel when he engages in the chase, he is at liberty—out of school hours—to go pretty much where he will and do what he pleases. This seems to be the attitude adopted by the average modern parent; while to it is occasionally added a certain pride in the boy's achievements. Thus, Tom has made a very creditable collection of birds' eggs or butterflies, and must exhibit his treasures when friends of the family are in the house; or Dick has carried off a prize at school for his portfolio of dried plants, and his father mentions the incident to his cronies, at the same time asserting his belief that "this kind of thing is a step in the right direction." He feels that in some mysterious way it "tends to keep the lad out of mischief." But he has yet to learn that it tends also to other ends of even greater importance; for instance, that it is calculated to influence in no small degree the boy's whole outlook on life; and that through him it will certainly redound to the welfare of the community at large. For there can be no denying the fact that we are still far from realising the full significance and importance of natural history regarded as a national asset.

SIGNS OF ENLIGHTENMENT.

Of course there are plenty of individuals of whom it may be said that their eyes have been opened—men like Sir Harry Johnstone, Sir E. Ray Lankester, or the late Captain Scott, who, in reference to his little son Peter, wrote to his wife: "Make the boy interested in natural history if you can; it is better than games." But in so far as the collective outlook of the nation is concerned, few signs of enlightenment are apparent. This may seem a hard saying; yet those who are in a position to review mentally the course of events in this country during the past quarter of a century will find small ground on which to dispute its accuracy. The culminating folly of attempting to close museums during the war, and incidentally to hamper much valuable educational and research work, was not merely condoned, but actually applauded, by considerable sections of the population. The

line of argument adopted seemed to be this: that museums and all that they represent are innocent luxuries enough, meet for enjoyment in ordinary times; but that all such intellectual trimmings and fripperies must be ruthlessly discarded by a nation suddenly called upon to assert its rights and defend its liberties. This attitude of mind is paralleled by that which prompts us to rebel against any part of school time being formally devoted to studies, which, in our ignorance, we still regard as little better than specialised forms of play. Says Paterfamilias: "I pay a big fee in order that my boy may be equipped for the battle of life; if the hours that should be devoted to serious studies are spent in butterfly-hunting, or in tramping over the countryside with a geologist's hammer—surely both he and I are losers?" Says the ratepayer: "Free education for the masses is all very well: we need efficiency in the rising generation; but why waste my money in teaching the little beggars to name wild flowers at sight?"

THE INCIDENCE OF THE WAR.

Now during the period of the war these questions have been furnished with conclusive answers of a highly practical and convincing kind, sufficient (so, at least, it would seem) to silence criticism for all future time. But dare we hope that this will prove to be so? Unfortunately, the outlook is far from reassuring. The tendency towards inertia is fatally strong in official bodies; and for the rest we must depend chiefly upon popular sentiment, which is notoriously fickle, and—in the absence of a strong energising principle applied from without—eminently conservative. What seems to be needed is a strenuous and sustained newspaper campaign, with its happily inspired catch-phrase and the rest of the paraphernalia which are apparently indispensable if the attention of the man in the street is to be caught and held. In such a campaign, the material aspect of the matter would, for obvious reasons, be given more than its due share of prominence. Our periodical publications would abound with articles under such titles as—"Why it Pays to Study Nature," or "Naturalists who have become Millionaires." Inevitably the history of the great war would be drawn upon to provide "modern instances," and these—even if shorn of that modicum of exaggeration in which the soul of your born journalist all unconsciously delights—would make surprising reading for the masses, and bring home to them the extent of man's dependence upon Nature and the urgency of the need that he should strive to comprehend her methods and abide by her laws.



Fig 1. The winged seed of *Zantedhaa neriocarpa* from Java



Fig 2 Burrows driven in timber by the Ship worm (*Teredos*).
These shell lined tunnels inspired Brunel



Fig 3.—Thayer's Model.
(See text for explanation.)



Fig 4. Young Puss-moth Caterpillar on a Poplar leaf.
It looks like a hole torn in the leaf substance.



Fig 5. Full grown Puss moth Caterpillar in its characteristic attitude, hanging back downwards from a leaf stalk.

SOME "MODERN INSTANCES."

At the commencement of the war, practically all Germany's military monoplanes were of the Taube (in English, "Dove") type. It is related that the designer of this type of machine—an Austrian millionaire named Ettrich—took his idea from the beautiful winged seed of *Zanonia macrocarpa*, a climbing herb indigenous to Java (Fig. 1). That these seeds, some of which measure as much as seven inches across the "plane," bear a striking resemblance in outline to the German "steel dove" cannot be denied; and when shaken from the plant, they float away on the breeze over wide stretches of country—sometimes for miles—ere they fall to earth. For the literal truth of the story, however, the present writer is unable to vouch, but it serves to illustrate the point upon which he desires to lay stress, viz., that the close observation of nature—even if it be undertaken quite aimlessly—is not necessarily a waste of time. On the contrary, something may be learnt—something, indeed, usually is learnt—which tends to dispel the mists of uncertainty, thus permitting us to pursue our labours in the light of a more complete understanding. And this is not less true when the question is judged from the purely material standpoint, than when aesthetic considerations are taken into account. Yet it is a remarkable fact that very few inventors of the past have drawn their inspirations direct from Nature. In other words, man can rarely be convicted of plagiarism in this respect; rather, his ideas seem to have originated *de novo*, the similarity of results being traceable, perhaps, to that mysterious unity of purpose which seems to rule the destinies of mundane things. When preparing the plans for his famous lighthouse, Smeaton was certainly influenced by "the natural figure of the waist or bole of a large oak," for he makes due mention of the fact. Similarly, Paxton translated the framework of the giant water-lily leaf—*Victoria regia*—into the iron lines of the Crystal Palace; while Brunel carefully studied the operations of the ship-worm (*Teredo*), and subsequently adopted its methods when driving his Thames tunnel (Fig. 2). But these are exceptional cases. If we turn over the pages of an interesting, if somewhat superficial, book—"Nature's Teachings," by the late Rev. J. G. Wood—in which some hundreds of instances are cited "to show the close connection between nature and human inventions,"—we shall not fail to notice how rarely the author is able to establish anything beyond mere parallelism. Indeed, in his preface he evidently disclaims any intention to do more than this. But he does not fail to read us a moral, which we of to-day may well take to heart. For, as he says, the corollary of this matter is

obvious—it is, that “as existing human inventions have been anticipated by nature, so it will surely be found that in nature lie the prototypes of inventions not yet revealed to man.” Surely this points out the royal road to would-be inventors of our generation!

“CAMOUFLAGE.”

In his chapter on war and hunting, Wood compares the methods of concealment and disguise adopted by man with those that may be observed in the animal kingdom. He even remarks that “in the late Franco-German war the principle of concealment was largely used, and when cannon were brought into the field for the purpose of attacking fortresses, they were always hidden under branches of trees, so that the enemy should not distinguish them from ordinary features of the country.” But in Wood’s time our knowledge of what science now calls “protective resemblance” was relatively slight; while the art of camouflage (*) as it is interpreted to-day, was definitely an outcome of needs manifested and experiences gained during the earlier phases of the great war. Doubtless, in special cases, the remarkable resemblance of animals to objects among which they were habitually found, must have been familiar to mankind from very early times. Such creatures as stick-insects and leaf-like butterflies could scarcely have passed unnoticed as soon as our forefathers began to take intelligent cognizance of their surroundings. But it was long before the conclusion was reached that the colours of animals are rarely—if ever—laid on in a hap-hazard way; and that in a high percentage of cases the object in view is concealment.

“THAYER’S LAW.”

An important historical landmark in the growth of our knowledge concerning protective colouration in nature was set up by Mr. Abbot H. Thayer, the American artist-naturalist. He showed that the presence of an animal, even if its tints accord perfectly with the background against which it is seen, may be betrayed to its enemies by the sharpness of its outline, or by the shadow that it casts; and he reminded us that an artist, by the process known as shading—i.e., painting in shadow—produces the appearance of relief, or solidity, upon his flat canvas. Now Nature—so Mr. Thayer claimed—often aims at producing the opposite effect.

(*) The word is evidently derived from the French substantive *camouflat*, which signifies the smoke of burning paper blown into any one’s face; an affront; a rap over the knuckles.

Her shading results in what may be termed a painting out of shadows, with the result that the appearance of solidity is effaced. To illustrate his theory in its bearing upon the colouration of large animals. Mr. Thayer constructed models (replicas of which are to be seen in several museums in this country) by means of which he proved that a bird which is dark on the back, shading through increasing paleness on the sides to white beneath, is far less conspicuous than one that is uniformly coloured all over—even though its tints may harmonise exactly with its surroundings. Both the dummy birds in the model are covered with the same grey material with which the box is lined. One is otherwise uncoloured, and is rendered very conspicuous by the illumination of its back, and the heavy shading of its under surface—thus showing that mere identity in the colour of an animal and its surroundings does not in itself afford protection, but rather the reverse. The other dummy is skilfully painted with a dark tint above, shading to white beneath, with the result that an effect of flatness and unreality is produced. At a distance of four feet it is practically invisible (Fig. 3).

OUR SOLDIERS' UNIFORM.

This principle of shadow neutralisation, or obliterative colouring, is now often spoken of as "Thayer's law." Its recognition has served to indicate new avenues for enquiry. We want to know precisely what is the effect upon each other of two differently-coloured areas in juxtaposition; what is the exact significance of certain types of pattern which occur commonly in nature—as, for instance, along the margins of butterflies' wings; why some animals, which are conspicuous when seen close at hand, should become to all intents and purposes invisible when looked at from a distance. Perhaps the reader may fancy that the solution of problems such as these can have little or no bearing upon the practical side of life; and we may reasonably assume that, five years ago, the most ardent naturalist would have felt bound, reluctantly, to concede this point. But nowadays every man who has seen service as a soldier knows how important in modern warfare is the part played by camouflage—literally, the art of life-saving by colour. The camouflage expert who achieves the most marked success in his vocation is really an artist and a naturalist rolled into one. Right back in the early days of the great war, it was pointed out by a naturalist that the designer of the British service cap must have been unacquainted with "Thayer's law," and that this ignorance must be costing the lives of many

soldiers. For all-round concealment, the colour of khaki is undoubtedly hard to beat. But the general effect of the uniform, judged from the standpoint of maximum protection, is marred by two details, which stand out prominently, viz., a bright line formed by the flat top of the cap seen in perspective, and below this a dark line caused by the shadow of the projecting crown. These tell-tale horizontal lines remain conspicuous when the rest of the soldier has melted away, so to speak, into his background. To obviate the defect, it would be necessary to darken considerably the crown of the cap, and to whiten the under surface of the projecting crown, as well as those parts of the band that are overshadowed thereby. It is highly probable that this plan would have been adopted, had it not been rendered superfluous by the use of steel helmets in the danger zone.

A LAW OF PROXIMITY.

It has been remarked by naturalists that some creatures, when lying motionless in an exposed situation, are not only protected by their own colouration, but derive benefit from the presence of any conspicuous object which may be near them. Indeed, there is some reason for thinking that certain beasts and birds habitually come to rest in a spot where they may hope to profit, for example, by the strong light reflected from a white stone or from the surface of water. Thus, the snipe is said often to lie near a tiny pool, or close to the margin of a pond or river. In such places the strong white reflection tends, by its very brilliance, to conceal all relatively sombre objects in the immediate vicinity. The eye is dazzled, as we say, by the brightness. Moreover, light-coloured objects tend to hold both the eye and the attention, with the result that neighbouring objects of less luminosity are overlooked. In this connection it is interesting to note that very many moths have a conspicuous pale-coloured spot or patch in the centre of each fore-wing. In other respects the fore-wings—which are exposed to view when the insect assumes its characteristic resting-pose—are marvels of protective colouring; and one would be inclined, at first thought, to suppose that the pale spot or patch must needs detract from the concealing effect. Yet the reverse is really the case; for it may be shown by actual experiment that, by rivetting the observer's gaze, they prevent him from detecting the outline of the insect; so that he fails to perceive where the real surface of the bark or stone (upon which the moth is resting) ends, and where the imitation begins. A knowledge of these and kindred facts gleaned in Nature's fields led to the suggestion, made

early in the war, that a series of white objects scattered promiscuously near the trenches in full view of the enemy marksmen would render their shooting no easier, if, indeed, they did not serve seriously to deflect their aim; while it is possible that when (as was observed) the Germans made use of pure white sand-bags for building the parapets of their trenches, they were not acting freakishly, but had a definite end in view.

CATERPILLARS AND SUBMARINES.

Instances of how the naturalist's knowledge of protective coloration among animals has been turned to good account in the saving of human life might be multiplied almost indefinitely. Who would have dared to suggest, five years ago, that the common puss-moth caterpillar could teach us how to hoodwink the submarine? In the earlier stages of its development, this insect feeds chiefly at night, and rests during the day, in full view, upon the upper surface of a leaf, where—thanks to its coloration—it has the appearance of a hole torn or nibbled in the substance of the leaf (Fig. 4). But in the final stage, before changing to the pupa, it hangs back downwards either from the edge of the leaf, or from the leaf-stalk (Fig. 5). Its bulk is now considerable, and its colouring, briefly described, is pure leaf-green below, separated by a thin whitish line from the long dorsal "saddle" which ranges in tint from purple or purple-grey to cream. If one judged solely by this description, one might be pardoned for concluding that extreme conspicuousness was the end that Nature had in view. Yet, in truth, the puss-moth caterpillar is most perfectly hidden when in its customary environment. Mr. Joseph Neale, of Bournemouth, who has reared and studied in the open many hundreds of these larvæ, speaks thus of them. "In the full-grown larva the mimetic effect of the colour scheme is heightened by the light border which separates the green from the purplish areas, the thin light line picking out the design in accurate mimicry of high lights caught by thin leaf edges, or by the edges of holes perforated in leaf tissue. . . . The puss at maturity, hangs as is its wont back downwards from petiole or leaf-edge in an oblique position. When attached to its support at a high angle, and seen laterally as a passing bird might espy it, it presents the appearance of two green leaves against a background of purple bark or shade; while in a horizontal position—which on the average of occurrences in the foliage of a large *Populus* must be the commonest posture—the dorsal saddle is an accurate copy of the slightly upturned tip of a fore-shortened

leaf. So good is either resemblance that workmen shown the full-grown larvæ at two feet distance failed to detect them, or to recognise a caterpillar till convinced by the evidence of touch." Without labouring the point further, it is easy to realise how a recognition of some of the "laws" which govern the coloration of caterpillars enabled our Admiralty to camouflage merchantmen into inconspicuousness. Those who know the caterpillars, and have seen examples of the transformed ships, will not fail to trace the connection.

CASUAL OBSERVATIONS.

Of late years, it has become fashionable in what are called "scientific circles" to deprecate casual observations made in the field. The whole status of natural history has been raised, it is claimed, since the days of Gilbert White of Selborne, and the mere jottings of a country rambler must no longer take rank as evidence of first importance. It cannot, of course, be denied that incalculable gains have accrued from the adoption of new and more precise methods in the study of nature, but this admission scarcely warrants the assumption that all field naturalists whose training has not proceeded along the lines laid down by modern convention are nincompoops, and their conclusions or suggestions worthless. It may be that "judged by the standard of exactness lately introduced into the study, White's book is not even natural history—it must be classed in the literature of country life." Yet this statement—made quite seriously a few years ago in the pages of a reputable monthly—would seem to indicate a deplorable lack of insight and sympathy. Take a case in point. It was White who, in 1771, set down the following passage. "A full history of noxious insects hurtful in the field, garden and house, suggesting all the known and likely means of destroying them, would be allowed by the public to be a most useful and important work. What knowledge there is of this sort lies scattered, and wants to be collected; great improvements would soon follow of course. A knowledge of the properties, economy, propagation, and in short of the life and conversation of these animals, is a necessary step to lead us to some method of preventing their depredations." Could anything be more erudite, more pertinent, more clear-sighted? Here, in few words, is laid the foundation upon which the whole science of economic entomology has been erected. And what a part this science has played in the progress of civilization during recent years! A glimpse of its far-reaching influence may be gained by turning over the pages of the British Museum "Return" for 1916—the latest statistics of the

kind available at the time of writing. The blue-book itself makes rather dry reading ; but some of the information which it contains has been translated into language suitable for general consumption by Dr. F. A. Bathers, in the issue of the *Museums Journal* for February, 1918. From this source the following quotation is taken.

ECONOMIC ENTOMOLOGY TO-DAY.

"Of all the Natural History departments of the British Museum the Entomological is probably of the greatest economic importance. Insects are carriers of disease to human beings, animals, and plants ; they destroy our crops, our food-stuffs, and our clothing ; even solid structures are stealthily attacked by them and fall without warning into decay. Against this host of enemies the entomologists of the country are mobilised and their headquarters are at the Natural History Museum. Here works the Imperial Bureau of Entomology, which studies insect pests from all parts of the Empire, and hands over the material received to be preserved in the Museum for future reference. The Army Biscuit enquiry has previously been mentioned in these pages ; even those in high places have learnt from it that there is a value in the study of Micro-Lepidoptera.* Indeed we are informed that the mere labour of turning over infected biscuits in time of peace cost the country £10,000 a year, which has been saved by the recommendations of this committee. The Royal Society Committee on Grain Pests deals with the organisms that attack grain when in store and in course of shipment to this country ; the loss thus caused is great, and, as in the case of biscuits, is largely due to the larvæ of Micro-Lepidoptera. We can mention but a tithe of the matters on which the Department has given useful advice : insects attacking the envelope of air-ships, locust plagues, protection of telephone and telegraph apparatus in the tropics and elsewhere, warbles in cattle, deer, and army horses, numerous cases of damage to food-stores on H.M. ships and in private ownership, remedies for the cockroach in many hospitals, for body vermin on soldiers serving or in hospital, and for the rice-weevil in connection with beri-beri, serious ravages of the cotton worm on a plantation in Montserrat, the plague of mosquitoes in the trenches and in this country. The investigation of the last-mentioned is still in progress, and specimens, accompanied by notes as to their occurrence and habits, will be gladly received by the assistant in charge."

* This term is without definite significance in modern classification. It must be taken merely as meaning " the smaller moths."

WAR-TIME ALLOTMENTS.

The case of war-time allotment-holders is also one of great interest and significance. In them we saw a vast army of agricultural workers called suddenly into being. They were drawn from all sections of society, and it is not too much to say that the majority of them possessed only the scantiest knowledge of how to set about the task which they had undertaken to perform. Yet the addition which they were able to make to the country's food supply during the first year of their effort far surpassed all expectation. Of course the credit for this splendid achievement was due in large measure to the experts, who industriously disseminated information and advice. For without this corresponding ebullition of education hastily adapted to meet the special needs of the occasion, much of the enthusiasm and energy of the actual workers would have been wasted. Government departments put forth unprecedented efforts, and much praise is due to local authorities, and in many instances to local museums, whose curators, besides holding themselves in readiness to assist all comers, frequently organised courses of popular lectures. Indeed, it is to be hoped that much has already been done towards the removal of that old stigma that museum officials in general purposely maintain an attitude of "academic remoteness" from the practical needs of mankind. This may have been the case thirty or forty years ago, but it is certainly not so to-day.

THE CASE FOR MUSEUMS.

Unfortunately, large sections of the public still believe that all such matters as the identification and classification of plants and animals, and the preservation and storing of specimens for reference in case of need, are of little consequence in so far as the affairs of everyday life are concerned; and that they cost the nation a good round sum of money each year without yielding an adequate return. It is quite true, of course, that museums need not, and should not, attempt to justify their existence solely upon the score of the practical or economic value of the work which they do. Nevertheless, no chance should be lost by those in authority to disprove the supposition that the formation of natural history collections serves no useful purpose, and is nothing more than a harmless form of acquisitiveness. A particularly good example of the manner in which science, acting through the agency of a museum, can assist industry, is recorded by Dr. Bathers in the issue of the *Museums Journal* for May, 1918. It appears that about ten years ago the sugar-canes in a part of Mauritius became infested

by a species of beetle-larva, which ate their roots. The Government Entomologist on the spot was called in, and he provisionally (incorrectly, as subsequently appeared) identified the beetle as a species belonging to a particular Lamellicorn genus which is characteristic of Africa, and of which two species are recorded from the Madagascar region. Various efforts were made to exterminate the pest; but although twenty-seven millions of insects were estimated to have been destroyed in less than half a year, the species continued to multiply and spread, and there was serious risk of ruin to the whole sugar industry of Mauritius. Meanwhile, the Entomologist of the island had wisely forwarded specimens to the British Museum for more accurate determination; and here it was found that the beetle belonged to the American genus *Phytalus*—not to an old-world genus, as had been at first supposed. But no description or record of the species could be found: and it was only after prolonged search in the vast collections of the Entomological Department that three specimens, labelled “Trinidad,” were eventually discovered.

TRACKING DOWN A BEETLE.

“This was evidence,” continues Dr. Bathers, “that the species occurred in the West Indies, though unnoticed by the entomologists of those islands. The latter fact indicated that it could not be causing so much damage to the sugar-canes in its native home. Therefore, the next step was to track it down, and to discover its natural conditions of life, and, above all, what served to keep it in check. A skilled entomologist who was visiting the West Indies was entrusted with specimens from Mauritius, and eventually found both beetle and larva at the roots of cane-stumps in Barbados. How, then, is it that the sugar crop of Barbados has not suffered from the attack of this larva to a noticeable extent? This depends on two natural enemies. One of these is the so-called ‘blackbird,’ (*Quiscalus*), which follows the workmen when rooting up the cane-stumps and eats the larvæ. It cannot, however, reach the larvæ underground. The other enemy, though less conspicuous, is more successful. Attached to one of the larvæ brought back from Barbados to the British Museum in spirit, there was found a tiny grub. Its appearance and the manner of its attachment suggested that it belonged to one of the Scoliidæ, those solitary wasps which paralyse Lamellicorn larvæ so that they may form food for their own young—an operation well known to us all from the account by Fabre. Further research proved the grub to be the larva of a

species of *Tiphia*, a Scoliid common in Barbados, though its economic importance had not been realised. An allied species of Scoliid exists in Mauritius but has not attacked the invader, which being thus quit of its original enemies has multiplied to the enormous extent previously described. The *Phytalus* larva had no doubt been introduced into Mauritius with some cane-cuttings imported from the West Indies a few years before. It now became an important matter to introduce the Barbados *Tiphia*. This was less easy, for the voyage is a long one ; the insects died on the way, and more than one attempt had to be made before success was finally achieved. The wasp is now established in Mauritius, and has begun to spread, so that the future of the sugar plantations is assured."

MUSEUMS VINDICATED.

Dr. Bathers says truly that this romance of modern science is worthy of special note, not merely because of its genuine interest, nor because of the large property at stake, but because it shows with unquestionable clearness the precise part which should be played by a museum in all enquiries arising out of national work. He sums up the points as follows : " Until the insect was accurately determined, no successful remedy could be suggested. The insect could not be determined by the very capable Entomologist of Mauritius in the absence of the necessary collections for comparison. Indeed, since the species had never been described, it was possible to run it to earth only by means of the great collection that has been accumulating for over a century at the British Museum. Although the museum specimens were not actually named, still, they were properly arranged in their correct genus and family, so that the specialist capable of determining the genus of the Mauritian specimens was able to make a comparison without ransacking the whole insect collection. Finally, the museum specimens retained their original locality label. The suggestion that the larva might have been imported from America was made as soon as the genus was correctly identified, but the Mauritian authorities regarded it as quite improbable. It was the actual running down of the species that proved the point, and led to the subsequent investigation and remedy."

SCHOOL-TIME NATURAL HISTORY.

The general methods of instruction in natural history, which experience has shown to produce satisfactory results, include work in the class-room as well as in the open air.

The pupils are encouraged to observe, with simple instruments, the phenomena of the weather, the clouds, the seasons, the stars, the moon, and so forth, and to compare their original records with the statements in the school text-books. Models in clay, or other materials, are made, it being found that the act of constructing them assists materially to fix facts in the mind. In this connection attention may fittingly be called to a little book (*) by Mr. W. Fortune Fowler, who, as the result of long experience, has come to the conclusion that every teacher should be capable of assuming the role of model-maker at pleasure. He should have at his disposal an accumulation of odds and ends capable, at short notice, of being pulled, or twisted, or pinned, or patted into shapes suggestive of the various types of scenery presented to us by the earth's surface. The aim is to make geography so real and clear to the child that it can without difficulty, and with that keen enjoyment which is the best spice for mind-hunger, comprehend such things as latitude and longitude, time and seasons, land contours, the flow of rivers, and how mankind, by his engineering feats, has altered Dame Nature's antiquated arrangements to his advantage.

Observations are also made out of doors upon animals, plants, the soil and rocks, and recorded in note-books. Specimens are collected and form material for subsequent class-work. The students are also encouraged, within reasonable limits, to keep under control in cages or aquaria, certain living animals, in order that their manner of life and motion may be watched and recorded. Garden work, too, is made a prominent feature, especially with children who evince a natural inclination towards horticultural pursuits. All kinds of crops are grown on a small scale; attention is paid to the theory and practice of digging, manuring, sowing, planting, etc., while the depredations of injurious animals and plants are observed, and the manner of checking them is explained. In all cases the children are required to keep a carefully written note-book, and are taught to illustrate their records by diagrams and sketches. The use of the photographic camera, also, is strongly advocated as a means of securing lasting pictures of things seen in the open.

MARKED PROGRESS MADE.

Working on these lines, marked progress has been made by isolated schools and colleges in different parts of the country. The results, moreover, are invariably satisfactory. Not only does almost

(*) *Handwork Methods in Teaching Geography*, by W. F. Fowler; published by Whealon & Co., Exeter.

every child give evidence of natural aptitude for nature-study and observation, but the time devoted to these pursuits appears in no way to detract from progress in ordinary school-work. On the contrary, the mind seems to develop more rapidly, and to gain in flexibility and strength. What is now wanted is that nature-study should be adopted as an indispensable item in the curriculum of every school throughout the land. There never was a time when Britain stood in need of a larger output of shrewd, observant, practical men than she does to-day—men who will prove capable of directing her manifold activities with success, and of availing themselves of the bounties which nature is ready to bestow unstintingly upon those who will take the trouble to understand her laws and abide by her precepts.

SECONDARY EDUCATION.

In the matter of secondary education, there is probably much that might be learned from a study of the methods adopted by the University of Wisconsin, which has established a remarkable influence over the educational, social, and agricultural development of the Middle West State. Dr. C. R. Van Hise, President of the University, was recently on a visit to this country, and in response to enquiries gave some interesting particulars of the character of the work which he controls. "One of our departures," he explained, "is the formation of farmers' institutes, short courses of lectures and demonstrations in different centres of the farming areas, one dealing, it might be, with stock-raising, one with dairying, one with grain or roots. As a development of this there are occasional short courses for farmers at the University itself, and at the same time sub-institutes, each with its resident superintendent, who is a regular official of the university, are established all over the State, specialising on the particular needs of the locality concerned. If, for example, potato-blight or oat-smut makes its appearance, the university representative on the spot will diagnose the trouble and advise as to its treatment, applying the recommended cure in part of a diseased field, and always leaving a few rows untreated to demonstrate by contrast the value of the remedy."

Dr. Van Hise then gave details of a piece of work that was accomplished in the south-east corner of the State, where large quantities of cabbage and onions are raised for the Chicago market. One year the land developed "cabbage sickness," and the whole crop was ruined. A pathological botanist from the university was immediately sent for, and he noticed that in each field several

plants escaped infection, and survived when all the rest perished. Working with these immune individuals as the starting-point, seed was raised at the university's experimental farm, and circulated, with the result that the whole of the affected area is now planted with a strain of cabbage capable of resisting entirely the conditions that threatened to ruin the whole industry.

"Another piece of work to which we attach equal importance," continued Dr. Van Hise, "is the education of the farmers in undeveloped areas. You know how disastrously virgin soil is exploited by the first cultivators. There was a danger of that happening in North Wisconsin, but the university took measures in time, sending up its agents with the pioneers to organise co-operation, advise on manuring, and the building of silos and the like, and in general to lay the foundation of a scientific and fruitful agricultural system."

SIR HARRY JOHNSTON'S PROPHECY.

The foregoing paragraphs, if somewhat desultory, should at least serve to convince the reader that our knowledge of natural history has stood us in good stead in the past, and especially during the ordeal of war. This is, indeed, the outstanding feature of our experience, and it should be accorded due weight in all deliberations anent our program of re-construction in this country. It is now several years since Sir Harry Johnston predicted that the end of the war would be followed by "a far-reaching revolution and reform in elementary education. And when this comes," he continued, "botany will certainly be amongst the elementary subjects that all persons of every degree will have to learn. Because botany, besides its religious value in enlightening us to the amazing beauty there is in the world, has its economic side of never-to-be sufficiently appreciated importance; since it is to trees and plants that we look and must look for the greater part of our food supply, for the materials of which our clothes are made (for the most part), for the making of paper, for the obtaining of timber, of fibre, and of vegetable fats." It is earnestly to be hoped that the fulfilment of this prophecy may not be long delayed. For botany does indeed lie at the very root of natural history; and the boy who receives sympathetic initiation into the brotherhood of botanists is unlikely to stop short or turn back when his school-days end.

THE FACULTY OF OBSERVATION.

The importance of natural history in the school-room has already been demonstrated beyond question. It would be worth a considerable expenditure of time and money did it do no more than

constitute a healthful counter to the strenuous mental effort—the striving to “keep pace”—that is nowadays demanded of the growing youth. The mind must have relaxation, and it is in every way desirable that this relaxation should take the form of a change of occupation, rather than of a complete mental and bodily idleness. In after life, too, the ability to turn from the stress and worry of the business or professional day to the calm of a favourite hobby is of inestimable value. And it is likely to prove profitable to us as a nation to train our children in the study of nature, especially as the supreme importance of nature-study lies in this: that it strengthens and develops the faculty of observation in the student. This faculty of observation—of being able to “see things at a glance,” and “put two and two together”—is woefully lacking in the mind of the average individual. Indeed, very few of us have formed the habit of getting “full value” out of our eyes and minds. Let the reader set himself some simple tests. Let him try to run over in his mind the various objects upon his own study table—objects which he has under his eyes and in his hands every day of his life—and he will discover that he has never yet *observed* many of these things. He could not describe them in detail nor in their relation to one another.

TO OBSERVE IS TO SUCCEED.

Now it is in this very particular that children who have been trained in nature-study score over children who have merely received education on the old-fashioned lines. They are able to observe—to see differences, similarities, novelties, and so on at a glance. And this faculty is of undoubted value to them in after-life, no matter what their ultimate calling may be. No sane person will translate what is known as the “nature-study movement” into an attempt to turn out upon the world a race of school-made naturalists. Some of the children may retain, or even add to, their store of special knowledge in after-life, but the majority will direct their energies along divergent lines. With one and all will remain, however, the power to observe.

It is surprising, too, in how many walks of life a little knowledge of nature, gained in the school-room, becomes of value to a man. He has learnt as a boy, let us say, to know at sight the injurious insects of an English kitchen garden, and the manner in which they damage the various plants. Years afterwards, he may go to some distant country to cultivate tea, tobacco, oranges, bananas or rubber; and his crops may be over-run by a pest. The insect is quite unknown to him, yet in the light of his school-gained know-

ledge he is able to form an estimate of its mode of attack, the manner and probable extent of its increase, and to make a shrewd guess as to the best way to check its depredations. In applying for advice, moreover, he is able to furnish the expert with precisely the material and information that will render speedy and effective assistance possible. And in all walks of life the same rule will be found to operate. The man who can observe accurately, and who has at his disposal a foundation of knowledge upon which to base his opinions, will succeed and prosper under conditions which would defeat the efforts of his neighbour whose potentialities of eye and mind lack development.

VIII.—SOME SUPPLEMENTARY OBSERVATIONS UPON THE FOREGOING ARTICLE ON "NATURAL HISTORY AS A NATIONAL ASSET."

By Thos. F. Plowman, Secretary and Editor.

SOME PERSONAL EXPERIENCES.

The writer of the foregoing article has correctly pointed out how, within the scholastic experience of many of us, youthful ardour was "cabined, cribbed, confined" when applied to studies—harmless, or even useful, though they might be—not included in the curriculum of the particular seminary (to use an Early Victorian phrase) at which you were supposed to be gathering fruit from the tree of knowledge.

While fully admitting the force of Mr. Bastin's main argument and its justification, there are one or two points concerning which I think there is something to be said on the other side. In the first place, he puts the main blame for what he deprecates upon the shoulders of parents and guardians, whereas, I think, that the schoolmasters might, in most cases, be credited with the largest share of responsibility, inasmuch as it is their particular business—if they rightly interpret their vocation—to be "the guide, philosopher and friend" of youth. No doubt there have been many instances of parental authority acting as a deterrent to the studies referred to, and the schoolmaster, who had to live, could hardly be blamed if he followed this lead. But, speaking generally, parents preferred to adopt an attitude of neutrality appropriate to affairs which, as they imagined, did not concern them so much as the schoolmaster.

Then I do not share the writer's pessimism when he says—"In so far as the collective outlook of the nation is concerned, few signs of enlightenment are apparent." I hope to be able to show in these supplementary observations that the signs of the times afford cause for a feeling of encouragement rather than of hopelessness.

With respect to the closing of museums and similar public institutions during the war, this was in many cases unavoidable in order to provide for the housing of Government Departments brought into being through Military necessities. Although it is manifestly undesirable without good cause to deprive the public, even temporarily, of such valuable educational mediums as those referred to, when the nation is in the throes of a great war and its very existence is at stake, sacrifices which would not be tolerated in the piping times of peace have, in view of the magnitude of the issue, to be endured. Some consolation may, however, be derived from the fact, within my own knowledge, that in some towns where the military have been quartered, special facilities in connection with Museums, Art Galleries and the like have been freely given to all men in khaki as an incentive to them to take an interest in the studies such institutions exist to promote.

It may possibly add to the interest of Mr. Bastin's article upon a subject possessing a special attractiveness at the present moment, if I add to his remarks one or two instances, on both sides of the question, coming within the sphere of my own personal experience. Hence these supplementary observations.

A DISCOURAGING EMBARGO.

In the middle 'fifties, I was at a school (of the type then prevalent) which discouraged anything not included either in the authorised programme of studies, or in that devoted to recognised "extras"—dancing, drawing and living languages, to wit. For such extras liberal-minded parents and guardians planked down something over and above the advertised fees, to the great content of the schoolmaster who took, as commission, a goodly percentage of these fees for himself. Although the instance I am about to quote, and the one following it, refer to inanimate objects, whereas Mr. Bastin has living organisms in his mind, the principle involved is the same in both cases.

The school happened to be situated in the midst of quarries in which many examples of the animal and vegetable life of the oolitic period were entombed. On our way to and from the Recreation Ground, situated some distance from the school, the proximity of such a happy hunting-ground offered tempting opportunities to

some of us to cultivate a knowledge of one of the most fascinating of studies and to experience the joy of collecting things which had a story to tell. I was a born collector, and so embarked enthusiastically upon a quest for such treasures as the quarries would yield. But, alas! geology was not on the authorized list of settled studies, nor was it officially recognised as either an "extra" or a recreation. So, ere long, my ardour was nipped in the bud, for the fiat went forth that any attempt at antediluvian disinterments must be forthwith renounced, on the ground that it was detrimental to the stone walls in which the district abounded. In their abysmal ignorance, our pastors and masters imagined that from such a source we derived our geological spoils.

A MODEL PEDAGOGUE.

But it is fair to say that, even in those days, the intellectual darkness was not universal, for here and there a teacher—the exception proving the rule—might be found who had a loftier appreciation than his fellows of youthful aims and aspirations. I was fortunate enough to have a happy experience of such a teacher, for the headmaster of the school I next attended was gifted with a sympathetic broad-mindedness which recognised that there could be something akin to a co-partnership between master and pupil. He had quite as great a regard for science as he had for classics, coupled with a remarkable knowledge of the human boy and his idiosyncracies. So it used to be said amongst us that, somehow or another—we knew not how—he could plumb the depths of our minds and draw deductions therefrom worthy of a Sherlock Holmes. He had in himself an exceptional store-house of general information, and once a fortnight he gathered us all together in one big class for talks upon subjects outside those included in the school's ordinary curriculum and, with the aid of specimens, diagrams and pictorial illustrations, brought home to us the wonders and beauties which science could, if applied to, unfold to us. We all looked forward with delight to these expositions and never missed them if we could help it. In this way, besides instructing us, he drew us out, and ascertaining by such means the bent of each individual mind set himself to utilise this knowledge for our benefit.

A RED-LETTER DAY.

He was a master of the Arnold type, as the following incident will show. He was a keen geologist, and his talks to the school upon the subject induced me, notwithstanding my previous discouragement, to continue a study of the flora and fauna of the world of

fossils. Once when we had a whole holiday, a kindred spirit and myself planned between ourselves a fossil-hunting expedition to Stonesfield, where Dr. Buckland first unearthed the remains of many marvellous monsters. To reach it, we had first to take train and then walk some way into the country. On the station-platform from which we started we found to our surprise our headmaster awaiting us, who, having got wind of our intention, asked if he might join us. We gladly welcomed his company; it was "an honour that we dreamt not of." He beguiled the way with fascinating converse, piloted us among the quarries, and showed us what to look out for, and then sat down with us at a wayside inn to a regular country meal at his expense. I remember how proud and pleased I was to find myself actually sitting alongside and feeding on equal terms with one whom I looked up to and revered as a superior being. After getting back at the end of a long day's real enjoyment, the kind-hearted man took us to his rooms in the college, further refreshed us, and then out of his geological store, presented each of us with a number of specimens for our own collections, as a memento of our day together; and a truly red-letter day it was, full of happy recollections.

Alas, death claimed our master all too soon, for he was a comparatively young man when, to my deep grief, he passed away. Outside my own family, there was no one to whom I was so much attached, and his death was one of the great sorrows of my life. I had previously suffered under a discipline of fear, for I had neither esteem nor regard for either of my preceding headmasters, and had not a single pleasant recollection attaching to them. So the coming into my life of one who was to me not only a teacher to be obeyed but a friend to be loved was a new and delightful experience, and it was sufficiently a revelation to induce me to remodel my ideas regarding schoolmasters generally.

If any of my school-mates, who had the good-fortune to come within the kindly radius of this model preceptor, still survive, they will have little difficulty in recognising, from the description, the Rev. John Baker, M.A., Chaplain of Christ Church, and Headmaster of the Cathedral School attached to Wolsey's Foundation.

HELPING HANDS.

Although I agree with the writer of the article to which these observations refer in deprecating the system that paid so little heed to individual proclivities, I cannot hold myself out as a victim, inasmuch as, with the exception of the one instance I have quoted, I was encouraged and helped by all and sundry in the pursuit of

my hobbies. In this connection, I would pay tribute to the bearer of a name—that of Acland—honoured in the West. The late Sir Henry Acland was in my school-days the Librarian and Trustee of the Radcliffe Library, Oxford, as well as a power in the University and a *persona grata* with the citizens. For the benefit of the latter, especially, he induced his co-trustees in the late fifties to throw open the Library on Saturday evenings during the winter months to such of the townsfolk of good repute as applied for permission to read there, and many working-men and others took advantage of this. It was no small boon to Natural History students, for at that time the shelves were loaded with the finest of fine copies of those magnificent folios which publishers of that generation, aided by a goodly subscription-list, were enterprising enough to give to the world. These works have since been removed to the University Museum to keep company with the zoological and other specimens to which they relate, and the building itself has been taken over by the Bodleian Library. I was then but a school-boy, but, my father being on friendly terms with Sir Henry, I was put on the privileged footing of a grown-up person and was allowed to spend my Saturday nights in “the best of all good company,” which books of world-wide fame can claim to be. I was thus introduced to those finely-illustrated tomes, among others, that recorded the ornithological researches of Audobon and Gould, the entomological gleanings of Duncan, and the geological investigations of Agassiz. This encouraged my bent in such directions and helped me to become an ardent entomologist and geologist to the advantage of my after-career.

About this time, an introduction to the late Professor Westwood gave me the privilege of helping him on half-holidays at the Taylor Buildings, where the Hope Entomological collections were housed previous to their transport to the University Museum. Among other congenial work, he put me in charge of the hospital, as he called it, and I had the responsible task, when the specimens were damaged in transit, of hunting among the *débris* for any missing legs, antennæ, etc., and, when found, of attaching them to the bodies to which they properly belonged. Apart from the interest I had in the work, it was a privilege and a delight to keep company with anyone so versatile and so genial as the Professor.

ELEANOR ORMEROD.

A remarkable instance, especially applying to Agriculture, of the value of a knowledge of Natural History from a National point of view is to be found in the life and work of that great public

benefactress, Eleanor Ormerod. How unmeasurable would have been the loss to the country at large had she in her young days suffered the discouragement meted out to many others and so have been forced to forego her entomological studies. Intensely interested in plant, insect and bird life, she directed her mind to seeing how she could best utilise her hobby for the common good. It did not take her long to realise what a pitiful lack of knowledge there was among agriculturists respecting their insect foes and she set herself to work to rectify this by tapping every possible source of information and by systematizing and correlating what had hitherto been isolated facts. It seems incredible that before she took up the work there had been no attempt in this country at any continuous, methodical investigation of a branch of science so important to agriculture, or any steps taken to bring under the notice of those most interested how they might best combat the many enemies so destructive to the well-being of their live-stock and crops.

With her own unaided pen and her own unaided means, she carried on for years, with the utmost efficiency, a work which in many European countries, in our Colonies, and in America, was conducted by departmental officials, and at the cost of the State. She wrote many manuals and handbooks upon the subject, which were published at intervals. But what was most apparent to the public may be said to have been the least part of her beneficent labours, for, becoming recognized as the great authority upon such matters, daily applications for information reached her from all parts of the world, and how she could ever successfully grapple, as she did, with her enormous correspondence was a subject of constant wonderment to all who knew her. When some special pest came to the front she took it in hand, and issued, gratuitously and at her own cost, thousands of leaflets of warning and direction. In order the better to disseminate abroad her store of knowledge, she mastered half-a-dozen foreign languages, including Russian, and at last, as multitudes of inquiries reached her from China, Japan, India, as well as from all Europe, Canada, the United States, South Africa, and Australasia, she was able to say "My work now literally girdles the earth." For some time her letters averaged over 100 a day, and one of her pamphlets was circulated by her to an extent of over 40,000 copies. It is impossible to over-estimate the value of her self-imposed and self-denying efforts, for her investigations into the attacks of the warble-fly alone saved cattle-owners immense sums of money.

When the Bath and West Society accepted an invitation to visit

St. Albans, in 1896, Miss Ormerod was residing there, and, with the sanction of our Council, I asked her to provide, out of her abundant stores, an exhibition illustrating the special study of her life, and this she kindly consented to do. Thus began an intimacy between us which only ended with her death. She had a personality of inexpressible charm, whilst her conversation showed a versatility of knowledge almost encyclopædic.

Miss Ormerod not only complied with the wish I have referred to by providing and arranging a most valuable and interesting collection of entomological specimens and drawings but she also attended daily to explain and answer inquiries upon the subject. Although she looked for no reward beyond the thought that she was doing some useful work for her fellow-creatures, she did not the less appreciate any little attention or any kindly recognition of her labours. Therefore, when the late King and Queen Alexandra, then Prince and Princess of Wales, visited the show, I asked our President (the late Lord Clarendon) if he would suggest to the Royal party a visit to the gallery over which Miss Ormerod was presiding. The Prince and Princess, with their daughters, gladly acted upon the President's suggestion, and spent some time in the building, deeply interested in all Miss Ormerod had to tell them. With the genial good nature which never failed them, they conveyed to her their cordial appreciation of her work in a way that greatly delighted her, and she assured me that the interview would always be one of her most happy memories.

Miss Ormerod received many honours from foreign and other public bodies, and the Bath and West Society conferred their honorary membership upon her and her sister, who was her valuable co-worker, and without whose aid, she said, she could never have fulfilled her mission. Almost the last distinction bestowed upon her was the honorary degree of Doctor of Laws in the University of Edinburgh; this being the first occasion on which the University had ever admitted a woman to this degree.

NATURE STUDY AT THE BATH AND WEST SOCIETY'S SHOW.

Before closing these supplementary observations, some reference should be made to the Bath and West Society which, as has been freely admitted by the Privy Council, the Board of Agriculture, and Parliament itself, has not merely lived on the strength of its traditions but has kept pace with the times and, as its records testify, has occasionally even been a little ahead of them. And so, it has held out a friendly hand to the Nature Study movement and has for

some years past accorded it a recognised place in the Society's showyard. This movement has by its encouragement and example done much to promote the systematic study in our schools and elsewhere of subjects coming within the sphere of every-day observation and from which, as Mr. Bastin has shown, valuable lessons can be derived with regard to the nation's self-protection.

In 1903, when the Bath and West Society first determined to recognise Nature Study in connection with the Annual Show, held that year at Bristol, it invited a large number of educational institutions to send contributions, and the response so far exceeded expectations that nearly three times the amount of space available was applied for. Several important School Boards, including London and Liverpool, were represented, together with nearly eighty colleges, schools, and societies. The exhibits consisted of zoological, botanical, geological, and mineralogical specimens and collections; drawings, photographs, plans, diagrams, models, appliances, apparatus, note-books, etc., illustrating the life-histories of animals and plants and the physical and geological features of the country.

Conferences of teachers and others interested in education were held, at which leading experts in Nature Study read papers dealing with various branches of the subject, and many interesting discussions followed.

The success of the initial exhibition and the interest taken in it, both by those actively engaged in education as well as by the general public, led to the establishment of such exhibitions as features of succeeding shows. This resulted in many excellent representative displays contributed to by Council Schools and other institutions whose governing bodies actively encouraged Nature Study work. The Society appointed qualified persons to judge the exhibits and awarded certificates of merit to those institutions reported upon as deserving the distinction.

AN EXAMPLE TO FOLLOW.

The cry has for long gone up that the rural population is drifting towards the town, but the despairing exhortation "Back to the Land" has to a great extent fallen upon deaf ears. We have begun to realise, that, among the minor causes for the exodus, has been the lack of interest in country-life, to which the colourless—from a rural point of view—nature of the education given in our village schools has been one of the contributing factors. When, in company with other representatives of the Bath and West Society, I visited Brittany some years ago on a mission of investigation, I

came into contact with an educational body known as "Les Freres de l'Instruction Chretienne" whose schools were conducted on the voluntary system and on lines similar to those which characterised our old National Schools. Agriculture was one of their five primary subjects of education, and the preface to an excellent agricultural primer used in these schools, after referring to the fact that the population of the country is practically drifting towards the towns, pertinently asks: "Is it not the duty of every man concerned in the well-being of his country to educate the young to fight against these false ideas, and to establish in the minds of the children a love of the country and of rural pursuits?" It then proceeds to observe that, "in order to give children country tastes and encourage them to understand and love agriculture, we teach them at school such subjects as may interest them in and attach them to the land."

It is a pity that in all our own rural elementary schools some similar course of instruction is not adopted, though it must be admitted that things are mending in this respect. We too often teach our children by pictures what a lion or a whale may be like, in case they should meet either of them on their way home from school; but we do not teach them the difference between turnip-seeds and charlock, how to graft or prune, or any of the hundred-and-one different subjects which would make agricultural life more attractive to them and help to retain them on the land.

"PAYING SUBJECTS."

Not many years ago—and we have not yet entirely grown out of some of our old beliefs—the object most frequently aimed at was the teaching of what may be described as "paying subjects," an acquaintance with which would bring grist to the money-making mill; this being regarded in most quarters as the main advantage accruing to educational attainments. From a commercial point of view, nothing within the scholastic area of rewards pays better, so far as schools and schoolmasters are concerned, than the winning of Scholarships and Exhibitions at Oxford or Cambridge for proficiency in dead languages. As this brings a plenitude of credit to a school and its Principal, it is small wonder—human nature being what it is—if a good deal of time and attention are given to these subjects and if promising pupils are specially encouraged and helped to devote their energies to acquiring sufficient information to secure one of these coveted prizes in the realm of scholarship. It is merely an application of the old country-side saying "You must go for the bridge that carries you over."

A TYPICAL OXFORD DON.

Dr. Gaisford, who came within the scope of my Oxford Memories, was one of the last survivors of the old race of University dons, now as extinct as the Dodo. In an address to the students he is credited with having expressed himself as follows :—

“ And now, my young friends, let me commend to you the study of Greek, for it not only raises a man above the common herd but not infrequently leads to positions commanding considerable emoluments.”

The divine was a reliable authority on both these points, for, he was typical of the dons of his generation who had a strong belief in the doctrine of infallibility, as applied to themselves, unalloyed by any doubt as to their own superiority over ordinary mortals. At the same time, the amount yielded by the various rewards for proficiency in classics which fell to his share in his studentship days, and later on, when the Professorship of Greek and the Deanery of Christ Church were held by him concurrently, fully justified him in speaking with authority, and in the light of practical experience, regarding the bread-and-cheese side of the subject.

THE OLD ORDER CHANGETH.

But we are living in an era of change, and since my boyhood there has been a broadening of the educational outlook, resulting in the conclusion, on the part of many of those in authority, that youth might find much worse employment, whether mental or physical, than in the pursuit of such studies as teach us to look from Nature up to Nature's God, even when the goal is not represented by a direct £. s. d. reward.

The acquisition of knowledge in order that one may enthrone oneself “ above the common herd ”—with all the self-glorification it implies— is now, happily, a motive which few would care to admit possessed them and is in direct conflict with the hopes and aspirations of all latter-day educationists, whose ideal is the levelling-up, so far as possible, of one and all to that standard of life and work upon which the nation's future so much depends.

THE INFLUENCE OF ENVIRONMENT.

These Supplementary Observations do not pretend to be anything more than fragments of personal history quoted as illustrations of some of the educational methods characteristic of the far-off days of the 'fifties and 'sixties. In deductions, we have to allow a good deal for environment, and, had I lived anywhere but at Oxford, I might have felt fully as strongly regarding the educational

shortcomings of those times as the writer whose article has furnished me with a text. If he himself has laboured under any discouragement, his writings testify that he has successfully overcome it.

My original intention was, in the form of a comparatively brief note, merely to substantiate in some particulars and to modify in others the conclusions of the contributor in question, but they seem to have expanded themselves very much of their own free-will and accord ; a result apt to ensue when autobiographical memories assert themselves.

My sands are running out—for they started in life's race in the early 'forties—and so under these circumstances if one has anything to say of the days that are past, there is a great temptation to say it 'ere it be too late.

IX.—ANNUAL REPORT UPON THE SOCIETY'S GENERAL OPERATIONS.

By Thos. F. Plowman, Secretary and Editor.

The following Report was submitted to the Council on Thursday, October 31st, 1918, and, on the motion of Mr. C. L. F. Edwards, seconded by Mr. H. B. Napier, was adopted, and ordered to be printed in the forthcoming issue of the Society's Journal :—

“The Council regret that they have once more to present their Annual Report to the Members under circumstances, arising out of the conflict the nation is engaged in, which have materially interfered with the carrying on of the Society's ordinary operations. They can only fervently hope that the time may not be far distant when an honourable and permanent peace may remove the disabilities under which the Society, in conjunction with all similar institutions, is suffering, and thus enable it to bring all its old activities to bear in the cause to which it has so long devoted itself.

Although, in view of the necessary restrictions imposed by the War, it has been impossible to hold a Show during the last three years, the Society's organisation has been maintained in a state of readiness to take advantage of the earliest opportunity of renewing this important feature of the Society's work, and the Council will continue to keep a watchful eye upon any developments of the national situation likely to render them free to take action. Meanwhile, they would welcome any suggestions from Members with regard to cities or towns which the Society could opportunely visit as soon as the present limitations are removed.

The Council desire to express the Society's indebtedness to Lord Coventry for kindly consenting to continue to act as President until such time as the Society is in a position to decide upon its future action with respect to a Show.

The Society's Show Plant is still being housed in a temporary erection on the site of the Worcester Show, and the Council are indebted to the occupier for so courteously permitting this.

Since the last Annual Meeting, the Council have lost by death an old and valued colleague in the person of Colonel the Hon. C. Byng, who for many years rendered devoted and valuable service to the Society as a Steward of Stock. In this capacity he had endeared himself to all with whom he came in contact, and his loss will be felt not only by his colleagues on the Council, but also by the Stockmen and others engaged at the Show, by whom his kindly consideration and unfailing courtesy will ever be gratefully remembered. In recognition of his services the Council had, at their Meeting in January last, unanimously resolved to nominate him for election at the Annual General Meeting as a Vice-President of the Society, but, unfortunately, his death after a serious operation prevented this being carried into effect.

The Council have sustained a further loss in the death of Major J. Bayly who was for many years a staunch supporter of the Society and a representative, on the Council, of the Western Division.

Death has also deprived the Society of many other old and valued supporters, among whom were: the Viscount Falmouth, a Vice-President who served the office of President of the Society with much distinction and devotion to the Society's interests in 1913; the Duke of Northumberland, a Vice-President and for many years a generous contributor to the Society's funds; Lieut.-Colonel Lord A. Thynne, D.S.O., M.P., and Capt. H. C. Hoare, who met their deaths while serving their King and Country; Lord Rhondda, Sir R. G. Glyn, Bart., The Hon. Mrs. Tremayne, Miss Talbot, Messrs. A. Brassey, Isaac Butler, H. Harpur, A. C. May, W. A. Morgan, W. J. Rees, H. C. Stephens, and W. Meyler Thomas.

The Council received with much gratification—which they are sure was shared by the Members generally, as well as by all others interested in Agriculture—the announcement that His Majesty had been graciously pleased to confer a Peerage upon one of their colleagues, Capt. Sir Chas. Bathurst, M.P., who, by the valuable service he had rendered in important offices of State and especially in connection with the greatest of our national industries, had earned in no ordinary degree so honourable a recognition.

The Council recommend that the retiring Members willing to serve again be re-elected Members of Council for the years 1918-1920, and that the filling up of any vacancies be postponed for the present.

At the request of the Board of Agriculture and Fisheries the Council suggested the names of the Marquis of Bath, K.G., and Mr. A. F. Somerville as representative Members of the Central Agricultural Wages Board and, in response to the invitation of the Western Counties Joint (Disablement) Committee of the Ministry of Pensions, Mr. S. J. Knight was nominated to represent the Society on that Committee.

The Council also acceded to the request of the Agricultural Section of the British Empire Producers Organisation by nominating a representative of the Society on that Section, and appointed Mr. W. Ashcroft accordingly.

In view of the dearth of good Milkers, the Council in 1917 formulated a scheme under which a sum of £200 was allocated for the promotion of instruction in Milking, and for rewarding proficiency in its practice. In accordance with this, grants have been made during the present year to such Agricultural Instruction Committees of County Councils within the area of the Society's operations as co-operated with the Society in facilitating the objects in question.

With the view of dealing with any matters of urgency arising out of the war the Council have appointed the following as Members of an Emergency Committee with power to act:—The President (The Earl of Coventry), The Marquis of Bath, K.G., Lord Strachie, Lord Bledisloe, Col. R. A. Sanders, M.P., Messrs. W. H. Clark, C. L. F. Edwards, S. J. Knight, T. Latham, H. B. Napier, and A. F. Somerville.

The Council, recognising the enormous importance of increasing the number of Pigs in the Country, passed a resolution strongly urging upon County and Municipal Authorities the advisability of doing everything in their power to further the keeping and breeding of Pigs, and a communication to this effect was sent to all Executive War Agricultural Committees and authorities of County Boroughs within the Society's area of operations.

In response to the request of the Ministry of Food that the Society should appoint representatives to meet the Committee on the Production and Distribution of Milk, in order to discuss with them the problems associated with the present position and the future development of the Dairying Industry, the Council, on the recommendation of the Dairy Committee, appointed Messrs. W. Ashcroft and A. F. Somerville, and these gentlemen accordingly met and gave evidence before the Committee.

The Council have continued the annual grant of £100 to the National Fruit and Cider Institute in the full belief of the value of its work. The Institute—the establishment of which was due to the practical and scientific research work initiated at Butleigh by Mr. R. Neville Grenville and conducted for some years, conjointly by the Society and the Board of Agriculture, under the direction of Mr. F. J. Lloyd, F.C.S.—is now attached to Bristol University. Experimental and research work is being actively carried on at the Institute, which there is every reason to believe is of essential service to those engaged in cider-making and fruit-growing. An arrangement has been made under which members of the Society can obtain from the Institute, free of charge, analyses of cider apples and perry pears.

The Institute has also undertaken to distribute to the Society, or to persons nominated by it, free of charge, a selection of trees which have been worked with the best varieties of cider apples and perry pears, and has conferred upon the Society the privilege of nominating, free of all fees, one student for a course of instruction in the theory and practice of fruit-growing, cider-making, etc., to be held by the Institute at the University of Bristol.

With a view to assisting farmers and others in dealing with insect and other pests which affect agriculture, horticulture, etc., the Council have availed themselves of an offer from the Board of Economic Biology of the University of Bristol to investigate the nature of any insect or other pest and report upon it free of charge.

A copy of the Society's Annual Journal for the current year has been forwarded to all Members not in arrear with their Subscriptions, and the Council have every reason to believe, from communications which have reached them, that such a record of the Society's work, as well as of the leading agricultural topics of the time, is appreciated by the Members and by the agricultural world at large.

The Council desire to acknowledge the generous manner in which the Members have supported the Society during the past year, and earnestly urge upon them and all who have the welfare of agriculture at heart the necessity of a continuance of this support, as it seems abundantly clear that, on the conclusion of the War, such help as agricultural organisations can render will be more than ever needed. In order to enable the Society to resume its full services in this respect, it is incumbent upon it to maintain its organisation intact, so that it may be in a position to deal at once with such problems as may arise upon the much-desired advent of an enduring peace."

X.—THE NATIONAL FRUIT AND CIDER INSTITUTE.*By B. T. P. Barker, M.A., Director.*

Each successive year of the war has made it necessary to limit to a constantly increasing extent the normal work of the Station, and to divert attention to matters of more immediate urgency arising from the prevailing conditions. This effect has been more pronounced during 1918 than in the preceding three years. As in 1917, the Station has been entirely deprived of the services of Capt. Gimingham and Dr. Lechmere. My own time has mainly been taken up with technical work for the Fruit Supplies and Preservation Branch of the Ministry of Food, which has necessitated my presence in London for the greater part of each week. Mr. Lees and Mr. Spinks have been continuously occupied with teaching work in connection with the course of training in fruit culture which has been conducted during the year at the Station on behalf of the Ministry of Pensions, in which also for the latter part of the time Mr. Grove assisted. The advisory work of the Station showed an increase over that of the previous year and occupied a considerable proportion of the limited amount of the time remaining at the disposal of the staff. It was inevitable therefore that the volume of research in progress should be reduced greatly below the usual standard; and the investigations which have reached a stage suitable to report upon are few in number.

In view of the extremely difficult conditions under which the work has had to be conducted during the past four years it must be considered satisfactory to have been able to have reached the end of the war without more serious curtailment, and there is every prospect that work under normal conditions will be resumed very shortly. Capt. Gimingham's services are now again available, and Dr. Lechmere has returned after four years' internment in Germany.* The course of instruction in fruit culture for officers has been concluded, and it is hoped that no further calls of this nature on the Station will be necessary. The work for the Ministry of Food is nearly at an end, and it is expected that at an early date the whole of the scientific staff will be free from any outside demands on their time. There is also some prospect that additional assistants may be secured.

The position with regard to the work in the fruit plantations is

* Since this Report was sent to the press the Station has sustained a severe loss by the untimely death of Dr. Lechmere, who succumbed to an attack of pneumonia after a few days' illness.

less promising. During 1918 attention was concentrated on food production and the cultivation of the plantations was maintained very largely by the aid of soldier labour and of German prisoners. The incessant wet weather since the middle of July has, however, been a serious hindrance and all operations are in a very backward state. The prospects for labour in the immediate future are doubtful and it seems unlikely that the plans which had been arranged for 1919 can be fully carried out. To what extent they can be developed depends mainly on the weather during the first few months of the year and of the labour available during that period.

During 1918 the arrangements foreshadowed in the last Annual Report with regard to the acquisition of additional land have been completed and the Station has now about 53 acres of land at its disposal. Of the land recently acquired 13 acres of grass were broken up in the early part of the year and planted with spring wheat. About five acres of potatoes were also grown. The greater part of the remainder of the land was fully cropped with fruit and vegetables. Now that the food situation of the country has improved, it is intended to proceed with the planting of fruit for experimental work with all possible speed. A portion of the land is being devoted to nursery work, the stocks of fruit trees in the country having been reduced to a very low point. In view of the need for renovation of existing orchards in the West of England and for the formation of new orchards to replace the large acreage of those now too far worn out to be amenable to treatment further supplies of standard cider and perry trees will be raised as quickly as possible.

It is not proposed to enter into detail here concerning the numerous activities of the Station during the past year with regard to outside work, but the following summary will suffice to show that, although its normal research investigations have had to be restricted, it has been able to assist materially in many matters of immediate importance in which agriculture and horticulture have been concerned.

The utilisation of a portion of the superabundant cider fruit crop of 1917 by making a form of apple jelly was dealt with at some length in the Annual Report for that year. The whole of the produce for that season was disposed of very quickly in the early part of 1918, and a large demand had to remain unsatisfied. At the request of the Ministry of Food arrangements were then made for the manufacture of the jelly on a very much larger scale from the prospective 1918 crop of cider fruit, additional factories at Hele and Hereford being organised and equipped. The failure of the apple crop and the consequent need of the whole of the cider fruit crop for jam manufacture made it impossible to proceed with the original plans.

The accompanying shortage of other fruits rendered it necessary for jam manufacturers to utilise blackberries, marrows and rhubarb to a much greater extent than heretofore. Since those materials produce jams which normally are deficient in setting properties, it was decided to remedy this defect by the use of the jellying material contained in cider fruit, and accordingly arrangements were made with the Ministry to produce at Long Ashton from freshly pressed pomace an apple extract which possessed the required setting properties. The result of this work has been to increase the jam supply by several hundred tons. A number of experiments were made for the Ministry in the direction of the manufacture of jam substitutes. Some interesting results were obtained, although occasion to proceed with production on a commercial scale did not arise, since the shortage of jam supplies did not reach a critical stage owing to the cessation of hostilities permitting the import of fruit.

The utilisation of cider fruit by the jam trade and for culinary and dessert purposes on the lines suggested in the last Annual Report intensified seriously for the cider trade the situation created by the failure of the crop, and there was at one period a risk that cider-making during the 1918 season would be prohibited. The action of the Institute, however, after consultation with representatives of the cider industry, resulted in a portion of the crop being secured by makers who were authorised to purchase apples for conversion into cider under a license issued by the Ministry of Food. In view of the need to increase the supply of drink a special allowance of sugar was granted by the Royal Commission on Sugar Supplies to enable the output to be increased by the making of "small" cider in the manner proposed in last year's Report.

A number of miscellaneous experiments on matters arising in connection with fruit and vegetable preservation have been made for the experimental factories of the Board of Agriculture at Dunnington and Broom Junction and also at the request of the Horticulture Division of the Food Production Department.

For the Supplies Division of the same Department an extensive series of experiments on the spraying of potatoes for the prevention of "potato disease" or "late blight" (*Phytophthora infestans*) was carried out at Long Ashton. The Station also undertook on behalf of the same body the organisation of a scheme for spraying with horse-drawn machines the potato crop in Somerset, at the request of the War Agricultural Executive Committee of that county. Three machines were supplied by the Department for this purpose. The county was divided into three main areas for the work and one machine was allocated to each area under the charge of specially-

trained men. Soldier labour was provided and the men received their training at Long Ashton. In spite of bad weather which supervened for three or four weeks at the most critical point of the spraying season, over 150 acres of potatoes were dealt with in the county under this scheme.

Acting in conjunction with the Food Production Department, the Institute has appointed a special Committee, including representatives of the counties of Devon, Gloucester, Hereford, Monmouth, Somerset, and Worcester, to deal with the question of the conditions of farm orchards in the West of England and to advise as to measures which can be taken to remedy the present unsatisfactory state of affairs. An endeavour is being made to ensure adequate representation on this committee of all interests concerned, and it is hoped that its labours will result in material benefit not only to agriculturists in the western counties, but also to the fruit, cider and other related industries.

On behalf of the Ministry of Pensions, a year's course of training in fruit culture for partially disabled officers was begun at the Station in February, 1918, for which thirteen selected men entered. The varying degrees of disability of the students rendered it extremely difficult to conduct the course under satisfactory conditions, but arrangements have been made for those who were able to complete it to supplement this preliminary training by a further year's experience on commercial fruit farms. The course consisted partly of lecture and laboratory work in chemistry, botany, and entomology in relation to horticulture and partly of practical training in the operations of fruit culture conducted in the fruit plantations at the Station.

In addition there have been taken up various investigations which have arisen through the work of the Natural Products Committee of the Royal Society and of the Fruit and Vegetable Preserving Committee of the Food Investigation Board of the Department of Scientific and Industrial Research, the Director having been appointed a member of both of these Committees.

During the year an Advisory Horticultural Committee of the Board of Agriculture and Fisheries was formed, and the Institute was invited to nominate two representatives, one to represent in particular the cider industry. Mr. Edward Bond, of Messrs. Wm. Evans & Co., Ltd. and myself as the Director have been appointed to serve on behalf of the Institute.

Mr. Lees has been nominated to represent the Institute on the Horticultural Sub-Committee of the Somerset War Agricultural Committee.

In view of the recognised need for increased provision for education and research various schemes for the development of agriculture and horticulture in those directions are under consideration by the Board of Agriculture. At the request of the latter body a scheme has been prepared for the extension of research in fruit culture and related subjects, which will, if approved, ensure a considerable development of the Station at Long Ashton.

The individual sections constituting the remainder of this Report have been contributed as follows :—

Single Variety Cider Trials, 1917-18 : by O. Grove.

The Preserving Value of Various Spices and Essential Oils :
by O. Grove.

The Influence of Concentration of Sugar Solutions on the
Growth of Micro-organisms : by O. Grove.

Potato Spraying Trials, 1917 : by G. T. Spinks.

Burgundy Mixtures and other Copper Sprays : by G. T. Spinks.

" Reversion " and Resistance to " Big Bud " in Black Currants :
by A. H. Lees.

SINGLE VARIETY CIDER TRIALS, 1917-18.

The experimental work with cider during the season 1917-18 was to a large extent suspended because of the making of the apple orchard jelly by concentration of cider apple juice. This work lasted from September, 1917, to February, 1918, and about 156,200lbs. of the jelly were made. The process was described in last year's report.

The single variety trials were upon a very reduced scale, only eight different varieties being dealt with, all of which had been tested in previous years.

The following varieties were used :— Cap of Liberty, Butter Box, Bickington Grey, Gatcombe, Kingston Black, White Norman, Never Blight, and Chisel Jersey. Of these Butter Box, Gatcombe, and Chisel Jersey produced ciders of merit. The first, especially, was a very good cider. The other five varieties did not produce ciders up to the standard of earlier years. They were rather thin and featureless, lacking also in bouquet. This was largely caused by the low specific gravity of the juices. As usual in a year with a heavy crop the gravities were very low. Only in a very few cases did they reach 1.050. The great majority of the juices used for cider and for jelly making had gravities of 1.042-1.045 only.

ANALYSES OF SINGLE VARIETY CIDERS.

Name of Variety.	Composition of Juice.			Specific Gravity, May, 1918.
	Specific Gravity.	Malic Acid per cent.	Tannin per cent.	
Never Blight ..	1.048	.48	.20	1.018
Butter Box ..	1.045	.58	.15	1.022
Bickington Grey ..	1.050	.90	.20	1.023
Cap of Liberty ..	1.045	1.02	.21	1.026
Gatcombe ..	1.046	.60	.18	1.028
Kingston Black ..	1.048	.67	.17	1.031
White Norman ..	1.042	.29	.16	1.010
Chisel Jersey ..	1.058	.24	.45	1.024

THE PRESERVING VALUE OF VARIOUS SPICES AND ESSENTIAL OILS.

Owing to the shortage of tinplate there was a danger of the waste of a portion of the 1918 tomato crop required for tomato pulp. The pulp is normally preserved in sterilised tins; but supplies of the latter being limited, the Ministry of Food desired to find an alternative method of preservation in cask without the addition of preservatives unsuited for food products.

Some experiments were accordingly carried out to find the preserving action of several spices and essential oils. The work was done with the assistance of Captain D. Jessop, of the Ministry of Food. Many of the substances used as spices or herbs, *e.g.*, thyme, mint, pepper, cloves, cinnamon, and others, contain bodies which act as strong deterrents upon bacteria and other micro-organisms causing deterioration of food, and the object of the experiment was to find out if some of those substances or mixtures of them could be used as keeping agents, preserving certain kinds of food for some time at least, and the amounts necessary to reach that object, without interfering too much with the flavour of the foods.

For the first series of experiments tomato-pulp was used. The tomatoes were pulped in the ordinary way, the pulp was put into bottles, the preserving substances added and a few drops of a mixture containing different kinds of micro-organisms (bacteria, mycoderma, yeasts and mouldspores). The open bottles were then placed in an incubator, where a temperature of 25°C. was maintained.

SERIES I.

Extracts of mustard, celery seeds, horseradish, cloves, allspice, and cinnamon in alcohol, water, and diluted acetic acid.

The alcoholic extracts were made by adding 10 grammes of the substance to 40c.c. of an 80 per cent. alcohol and keeping the mixture for four days at 30°C. and filtering. In the case of the watery extract the substance was kept for one hour with four parts of water at 70°C., afterwards at 30°C. for four days and then filtered.

Substance.	Extracted with	Proportion added.	Result of Examination.
Mustard	.. Water ..	1%	.. Apparently no check on
"	" ..	2%	.. growth of the micro-
"	" ..	3%	.. organisms added.
"	" ..	4%	" ..
"	" ..	5%	" ..
"	.. 5% Acetic acid ..	1%	" ..
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	" ..
"	" ..	5%	" ..
"	.. 80% Alcohol ..	1%	" ..
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	" ..
"	" ..	5%	" ..
Celery	.. Water ..	1%	" ..
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	" ..
"	" ..	5%	" ..
"	.. 5% Acetic acid ..	1%	" ..
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	" ..
"	" ..	5%	" ..
"	.. 80% Alcohol ..	1%	" ..
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	.. Some check on the growth.
"	" ..	5%	" ..
Horseradish	.. Water ..	1%	.. No check on the growth.
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	" ..
"	" ..	5%	" ..
"	.. 5% Acetic acid ..	1%	" ..
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	" ..
"	" ..	5%	" ..
"	.. 80% Alcohol ..	1%	" ..
"	" ..	2%	" ..
"	" ..	3%	.. Some check on the growth.
"	" ..	4%	" ..
"	" ..	5%	" ..
Cloves	.. Water ..	1%	.. No check on the growth.
"	" ..	2%	" ..
"	" ..	3%	" ..
"	" ..	4%	" ..
"	" ..	5%	" ..

Substance.	Extracted with	Proportion added.	Result of Examination
Cloves	.. 5% Acetic acid	1%	.. No check on the growth.
"	" "	2%	.. " "
"	" "	3%	.. " "
"	" "	4%	.. " "
"	" "	5%	.. " "
"	.. 80% Alcohol	1%	.. Some check on the growth.
"	" "	2%	.. " "
"	" "	3%	.. Growth completely stopped.
"	" "	4%	.. " "
"	" "	5%	.. " "
Allspice	.. Water	1%	.. No check on the growth.
"	" "	2%	.. " "
"	" "	3%	.. " "
"	" "	4%	.. " "
"	" "	5%	.. " "
"	.. 5% Acetic acid	1%	.. " "
"	" "	2%	.. " "
"	" "	3%	.. " "
"	" "	4%	.. " "
"	" "	5%	.. " "
"	.. 80% Alcohol	1%	.. " "
"	" "	2%	.. " "
"	" "	3%	.. " "
"	" "	4%	.. " "
"	" "	5%	.. " "
Cinnamon	.. Water	1%	.. " "
"	" "	2%	.. " "
"	" "	3%	.. " "
"	" "	4%	.. " "
"	" "	5%	.. " "
"	.. 5 % Acetic acid	1%	.. " "
"	" "	2%	.. " "
"	" "	3%	.. " "
"	" "	4%	.. " "
"	" "	5%	.. " "
"	.. 80% Alcohol	1%	.. " "
"	" "	2%	.. " "
"	" "	3%	.. Some check on the growth.
"	" "	4%	.. " "
"	" "	5%	.. " "
Horseradish	.. Scraped and added to boiling pulp	4%	.. " "

As will be seen from the above table, the growth of the added micro-organisms was completely stopped by an addition of 3, 4 and 5 per cent. of an alcoholic extract of cloves, and the development was checked by 4 per cent. and 5 per cent. of an alcoholic extract of celery seeds, by 3, 4 and 5 per cent. of an alcoholic extract of horseradish, by 1 per cent. and 2 per cent. of an alcoholic extract of cloves, by 3, 4 and 5 per cent. of an alcoholic extract of cinnamon, and by 4 per cent. of scraped horseradish. In all the other cases the additions did not seem to have any unfavourable action upon the development of the micro-organisms. In all the cases the bottles were kept open, this being done to make the test

more severe. If the treated pulp had been put into completely filled and well closed bottles the results would presumably have been more favourable, especially as far as the growth of moulds and mycoderma are concerned.

The next series of experiments were carried out with the essential oils of cloves and cinnamon and combinations of the oils with salt and scraped horseradish.

SERIES II.

Oil of Clove.	Oil of Cinnamon.	Salt.	Horseradish.	Result of Examination.
·01%				No check on growth of the micro-organisms added.
·02%				" " "
·03%				" " "
·04%				" " "
	·001%			" " "
	·005%			" " "
	·01%			" " "
·02%	·001%			" " "
·02%	·002%			" " "
·02%	·005%			" " "
·02%	·001%		1%	" " "
·02%	·002%		1%	Slight check on growth.
·03%	·01%	2%	1%	Some check on growth.
·03%	·02%	2%	1%	Decided check on growth.
·03%	·03%	2%	1%	Growth completely stopped.
·04%	·005%	2%	1%	No check on growth.
·04%	·01%	2%	1%	Same check on growth.
·04%	·02%	2%	1%	Decided check on growth.
·04%	·04%	2%	1%	Growth completely stopped.
·05%	·01%	2%	1%	Decided check on growth.
·05%	·03%	2%	1%	Growth completely stopped.
·05%	·05%	2%	1%	" " "

The following experiments were carried out with essential oils. Malt extract was used instead of tomato pulp. The samples were inoculated with the same mixture of active micro-organisms as above and kept in the incubator.

SERIES III.

Name of Oil.	Percentage.	Result of Examination.
Absinth	·1%	Some check on growth.
Almonds	·1%	" " "
Juniper	·1%	" " "
Nutmeg	·1%	" " "
Lemon	·1%	" " "
Lime	·1%	" " "
Orange	·1%	" " "

SERIES III—*contd.*

Name of Oil.	Percentage.	Result of Examination.
Sage	.1%	Some check on growth.
Thyme	.1%	" " "
Rosemary	.1%	" " "
Lavender	.1%	" " "
Camphor	.1%	" " "
Eucalyptus	.1%	" " "
Cubeb	.1%	" " "
Cedar	.1%	" " "
Sandalwood	.1%	" " "
Savin	.1%	" " "
Pine	.1%	" " "
Peppermint	.1%	Decided check on growth.
Mustard	.1%	Growth completely stopped.
Spearmint	.1%	Decided check on growth.
Geranium	.1%	" " "
Rose	.1%	" " "
Bay	.1%	" " "
Origamun	.1%	Growth very nearly stopped.
Caraway	.1%	" " "
Aniseed	.1%	Growth completely stopped.
Parsley	.1%	Some check on growth.
Ginger	.1%	" " "
Pepper	.1%	" " "

In the last series of experiments combinations of some of the above oils were used.

Cloves.	Aniseed.	Cinnamon.	Caraway.	Origamun.	Salt.	Result of Examination:
.06%	.06%	.06%	.06%	.06%		Growth completely stopped.
.02%	.02%	.02%	.02%	.02%		Ditto
.01%	.01%	.01%	.01%	.01%		Decided check on growth.
.008%	.008%	.008%	.008%	.008%		Some check on growth.
.006%	.006%	.006%	.006%	.006%		Ditto
.004%	.004%	.004%	.004%	.004%		Slight check on growth.
.002%	.002%	.002%	.002%	.002%		Ditto
.01%	.01%					Very slight check on growth.
.02%	.02%					Ditto
.03%	.03%					Some check on growth.
.04%	.04%					Ditto
.05%	.05%					Decided check on growth.
.01%	.01%	.01%				Very slight check on growth.
.02%	.02%	.02%				Ditto
.03%	.03%	.03%				Some check on growth.
.04%	.04%	.04%				Ditto
.05%	.05%	.05%				Ditto
.02%	.02%	.02%	.02%	.02%	1%	Growth nearly stopped.
.02%	.02%	.02%	.02%	.02%	2%	Ditto
.02%	.02%	.02%	.02%	.02%	3%	Ditto

The experiments were not further proceeded with, owing to a favourable alteration in the situation as regards tomato pulp, but,

judging by the results obtained, it would seem possible to prepare a mixture of spices or essential oils which, when added in very small quantities to certain kinds of food, would act as a preserving agent and a flavouring agent at the same time. The oils of mustard, cloves, aniseed and cinnamon had a higher preserving value than any of the other kinds tried.

THE INFLUENCE OF CONCENTRATION OF SUGAR SOLUTIONS UPON THE GROWTH OF MICRO-ORGANISMS.

It often happens in jams and similar sugary preparations that fermentation sets up when they have been kept for some time, especially if they are put in a fairly warm place. This fermentation is generally caused by the growth of yeasts, or in a few cases by the development of bacteria or moulds capable of fermenting sugars. The jams depend principally upon the concentration of sugar as a preserving agent, if no antiseptics, *e.g.*, sulphurous acid, salicylic acid or others, have been added ; and the higher the sugar content is, the better the jam will keep.

Experiments were made to find the percentage of sugar necessary to prevent development of yeasts, bacteria, and moulds. Sugar solutions of different strengths, to all of which were added 2 per cent. of malt extract to provide the necessary food for the micro-organisms, were sterilised at boiling point and after cooling inoculated with a drop of a mixture of several kinds of yeasts, mycoderma, torula, and bacteria, together with mould spores. As all jams contain a certain amount of organic acid the samples were acidified with varying quantities of citric acid and in some cases salt. The sugar used was ordinary cane-sugar containing 95 per cent. of pure sugar. The samples were kept at room temperature and the results obtained are given in the following tables.

After 14 days the results were very nearly the same as after seven days. The mould-growth in the 65 per cent. series had increased a little and a trace of mycelium had developed in the first two (-1 and -2 per cent.) of the 70 per cent. series ; otherwise there was no difference.

After three months the results were the same as after one month. The only mould developed in all cases was the ordinary blue mould (*Penicillium glaucum*), although the samples had been inoculated with spores of several kinds. The growth was only on the surface of the liquids. According to these experiments yeasts and bacteria do not develop under the conditions mentioned above in a sugar

RESULT OF EXAMINATION AFTER THREE DAYS—SUGAR PERCENTAGE.

45°	50°	55°	60°	65°	70°
Citric Acid					
1% Some mycelium formed. Liquid cloudy. Development of yeast and bacteria.	A little mycelium formed. Liquid clear. No development of yeasts or bacteria.				
2%	"	"	"	"	"
3%	"	"	"	"	"
4%	"	"	"	"	"
5%	" (but less)	"	"	"	"
6%	" ()	"	"	"	"
7%	" ()	"	"	"	"
8%	" (very little)	"	"	"	"
9%	No development.	"	"	"	"
1%	"	"	"	"	"
1.2%	"	"	"	"	"
1.4%	"	"	"	"	"
1.6%	"	"	"	"	"
1.8%	"	"	"	"	"
2%	"	"	"	"	"
Salt.	"	"	"	"	"
5%	"	"	"	"	"
Some mycelium formed. Liquid clear. No development of bacteria and yeasts.					
1%	"	"	"	"	"
1.5%	"	"	"	"	"
2%	"	"	"	"	"
3%	"	"	"	"	"
4%	"	"	"	"	"
Control.					
Some mycelium formed. Liquid cloudy. Development of bacteria and yeasts.					
A little mycelium formed. Liquid clear. No development of yeasts or bacteria.					

Citric Acid.	Mould growth. Deve- lopment of bacteria and yeast.	Mould growth only.	Mould growth only.	Mould growth only.	Feeble Mould growth only.	No develop- ment.
1%	"	"	"	"	"	"
2%	"	"	"	"	"	"
3%	"	"	"	"	"	"
4%	"	"	"	"	"	"
5%	"	"	"	"	"	"
6%	"	"	"	"	"	"
7%	"	"	"	"	"	"
8%	"	"	"	"	"	"
9%	"	"	"	"	"	"
1%	"	"	"	"	"	"
1.2%	"	"	"	"	"	"
1.4%	"	"	"	"	"	"
1.6%	"	"	"	"	"	"
1.8%	"	"	"	"	"	"
2%	"	"	"	"	"	"
Salt.	"	"	"	"	"	"
3%	"	"	"	"	"	"
5%	"	"	"	"	"	"
1%	"	"	"	"	"	"
1.5%	"	"	"	"	"	"
2%	"	"	"	"	"	"
3%	"	"	"	"	"	"
4%	"	"	"	"	"	"
Control.	"	"	"	"	"	"

RESULT OF EXAMINATION AFTER ONE MONTH—SUGAR PERCENTAGE.

	45%	50%	55%	60%	65%	70%
Citric Acid.						
1%	Mould growth. Development of yeasts and bacteria, fermenting.	Mould growth only.	Mould growth only.	Mould growth only.	Mould growth only.	Very feeble mould growth only.
2%	"	"	"	"	"	"
3%	"	"	"	"	"	"
4%	"	"	"	"	"	"
5%	"	"	"	"	"	"
6%	"	"	"	"	"	"
7%	"	"	"	"	"	"
8%	"	"	"	"	"	"
9%	Mould growth. Very nearly clear. No fermentation.	"	"	"	"	"
1%	"	"	"	"	"	"
1.2%	Mould growth. Liquid clear.	"	"	"	Feeble mould growth.	No development.
1.4%	"	"	"	"	"	"
1.6%	"	"	"	"	"	"
1.8%	"	"	"	"	"	"
2%	"	"	"	"	"	"
Salt.						
5%	Mould growth. Development of yeasts and bacteria. Fermentation.	"	"	"	Mould growth only.	Very feeble mould growth.
1%	"	"	"	"	"	"
1.5%	Mould growth. No development of yeasts and bacteria.	"	"	"	"	"
2%	"	"	"	"	"	"
3%	"	"	"	"	Feeble mould growth.	No development.
4%	"	"	"	"	"	"
Control.	Mould growth. Development of yeasts and bacteria. Fermentation.	"	"	"	Mould growth only.	Very feeble mould growth.

solution of 50 per cent. or more. In a 45 per cent. solution development takes place if the acidity is below .8 per cent. At .9 per cent. it is very feeble indeed, and stops completely at an acidity of 1.2 per cent. An addition of salt of 1.5 per cent. also completely stops the development of yeasts and bacteria.

As regards the development of *Penicillium* the concentration necessary to check the growth is 65 per cent., but even at 70 per cent. there is a feeble growth after one month; the development is not completely stopped before the acidity is over 1 per cent. or the percentage of salt about 2 per cent. The mould-growth on the surface is very much influenced by the degree of moisture of the atmosphere, the drier the air the less the development. If samples are kept in a very dry atmosphere the growth stops at a lower concentration. This is due to the fact that evaporation takes place from the surface, and a thin layer of a higher concentration is formed, in which the mould spores do not germinate.

POTATO SPRAYING TRIALS.

An extensive series of potato spraying trials was carried out here in the Summer of 1918. The majority of the trials were arranged by the Food Production Department and were similar to other trials carried out at various centres. All the results here described were obtained on potatoes growing in the same field. Similar series of plots were arranged on (1) Up to Dates grown from Scotch seed; (2) Up to Dates grown from local seed; (3) King Edwards from Scotch seed and (4) King Edwards from local seed. In each case there were about forty plots, all the same size and shape. Each plot was $14\frac{1}{2}$ yards long and contained five rows of potatoes running lengthways, the rows being 30 inches apart. Each plot therefore had an area of two rods. One quarter of the plots were left unsprayed as controls, one quarter were sprayed twice with ordinary 1% Burgundy mixture, while the remaining plots received various treatments. As a comparison of the utility of various sprays the trials gave no result, hence it is not proposed to give a full description of all the sprays used. It is sufficient to say that most of the plots received two applications of one of the following sprays:—Bordeaux mixture, Burgundy with various proportions of soda crystals, Burgundy made with special forms of soda, Burgundy with substances added to increase adhesive powers, proprietary mixtures including powders applied dry, and Copper Stearate. A few plots were sprayed only once, and some were sprayed three

times. All the sprayings were done as thoroughly as possible with Knapsack machines.

The first spraying was done on June 21st and 22nd in unfavourable conditions, the weather being windy and showery. One point brought out by these trials was the good adhesive powers of practically all the mixtures under unfavourable circumstances. If only a Burgundy mixture has had time to dry it will not be washed off if heavy rain follows immediately. It was also found in several cases that a very good coating was left on the foliage when a drizzling rain fell before the deposit had even had time to dry properly.

The second application of spray was given on July 17th, no *Phytophthora* having yet been found on any of the plots. A few plots were sprayed also on July 31st, the potatoes all being quite healthy still. On August 3rd a careful examination revealed *Phytophthora* only on one plant of Up to Date and one plant of King Edward, the attack being very slight in each case. After that the disease made no progress for some time and it was not until about August 16th that it began to be widely distributed and at all noticeable. The lateness of the onset of the disease was presumably due to the character of the weather experienced in June, July, and the first half of August. The weather was almost always either hot, sunny and dry, or cold and rainy, and there was practically none of the warm, dull and moist weather which seems to be most favourable to the spread of *Phytophthora*. After August 16th, however, the disease spread rapidly, and by August 31st it was bad on the haulm on nearly all the plots. The King Edwards became diseased most rapidly, but the Up to Dates, although attacked about a week later, ultimately became just as badly diseased. No difference in susceptibility between plants from Scotch and local seed was noted.

In almost every case the sprayed plots were as badly diseased as those unsprayed. The only exceptions were those plots which had been sprayed on July 31st, which were protected against the "blight" to a marked degree, and showed up as green patches for several weeks after the rest of the plot had been blackened and stripped of leaves. It therefore appears that the mixtures (ordinary Burgundy and "Blighty") applied shortly before the disease appeared gave good protection; but the same and other mixtures applied a month before the appearance of the disease had no effect, probably owing to the quantity of new foliage formed in the meantime.

Under these circumstances no information concerning the relative fungicidal properties of the different mixtures was gained. As

regards the covering and adhesive powers of the different mixtures no appreciable difference was found.

Owing to continuous wet weather the tubers could not be lifted until November, and the sound and blighted tubers from each plot were then weighed. Taking an average it was found that spraying had made practically no difference to the total crop or the percentage of diseased tubers obtained from a plot. It was surprising to find that the King Edwards, the haulm of which had been so badly blighted, only yielded $1\frac{1}{2}\%$ of tubers which could be identified as blighted at the time they were lifted. Two months later a small quantity which had not been clamped were still keeping well without showing any more disease, but it was not known how those in the clamp were keeping. Of the Up to Dates, $7\frac{1}{2}\%$ of the tubers from Scotch seed and 10% of those from local seed were seen to be blighted at the time of lifting. Very many apparently sound tubers, however, developed blight a little later and so many became diseased that no clamping was done. It is thought that about two thirds of the tubers finally became diseased.

Apart from the spraying, these trials show very clearly the superiority, in this district, of Scotch over local seed. The local seed contained many rogues, large numbers of sets produced no plants at all, and the plants which did grow were much inferior to those grown from Scotch seed. But it is the weights of tubers produced which show most clearly the advantages of using Scotch seed. Local seed of Up to Dates produced $3\frac{3}{4}$ tons of tubers per acre, whilst Scotch seed of the same variety yielded $7\frac{1}{2}$ tons per acre. The figures of the crops of King Edwards are even more striking, local seed yielding $3\frac{3}{4}$ tons per acre, while the Scotch seed gave 10 tons per acre.

In addition to the above varieties of potatoes about half an acre of Scottish Farmer and a few rows of several other varieties were grown in the same field and gave some interesting information about their different degrees of susceptibility to *Phytophthora*. The most striking fact was the great resistance of Scottish Farmer to disease. On August 31st, when the haulm of Up to Dates was blackened and devoid of leaves, unsprayed Scottish Farmer growing next to it showed only occasional spots of disease; and on September 28th the Scottish Farmer was still green and only moderately diseased. The weight of tubers obtained from this variety was at the rate of $13\frac{1}{2}$ tons per acre, of which only $\frac{1}{3}\%$ were diseased. Provost was another variety which was resistant, though not so much so as Scottish Farmer. Arran Chief was less susceptible than Up to Date or King Edward, while May Queen was the most susceptible variety.

BURGUNDY MIXTURES AND OTHER COPPER SPRAYS.

The Proportion of Washing Soda to be Used.—There appears to be some doubt as to the relative proportions of copper sulphate and soda which should be used in the preparation of Burgundy mixture. It is now usually suggested that a Burgundy mixture should contain 1% of copper sulphate, that is to say, 4lbs. in each 40 gallons, but there is a difference of opinion as to the quantity of soda required. The formula which has always been recommended by the Irish Board of Agriculture contains 5lbs. of washing soda to every 4lbs. of copper sulphate. Two years ago the English Board of Agriculture gave 4½lbs. of soda to 4lbs. of copper sulphate as the most suitable proportions, but last year they recommended the Irish formula. Pickering has for some time maintained that the theoretically correct proportions are 7.2lbs. soda to 4lbs. of copper sulphate, and that this mixture is the best one for practical use. The experiments now to be described were started as the result of enquiries and suggestions from the Mond Nickel Co. No attempt has been made to find the chemical composition of any of the mixtures, which have only been investigated with regard to their fungicidal properties and the nature of the deposits they give. In the first place it was suggested that the best mixture, using copper sulphate and washing soda, was produced by the use of 4.25 parts of soda crystals to 4 parts of copper sulphate. A Burgundy mixture when freshly made contains a light blue gelatinous precipitate which remains in suspension for some time, but which eventually changes to a dense green crystalline form if the mixture is left standing. The Mond Nickel Co. tested Burgundy mixtures made up from different formulæ by leaving them standing and noting how long the precipitate remained in the gelatinous condition. It was found that a mixture containing copper sulphate and soda in the proportion of 4 : 4.25 retained the precipitate in the gelatinous state for the longest time, and it was suggested that this was therefore the most suitable for use as a spray. A mixture in which the precipitate has changed to the crystalline state is, of course, useless for spraying, for even if it were fungicidal it would not adhere to plants and could not even be applied successfully with a spraying machine.

Laboratory trials of various mixtures similar to the above were carried out here, the mixtures in each case containing 1% of copper sulphate, while the amount of soda was varied. In every case, 200cc. of the mixture were put in a tall glass cylinder and the time which elapsed before the precipitate crystallised was noted. The following table shows the results of a number of trials :—

Trial.	Proportion of Copper Sulphate to Soda Crystals.				
	4 : 3·5	4 : 4·25	4 : 4·5	4 : 5	4 : 7·2
1 Precipitate crystal- lised in ..		3½ days	2½ days		
2 Ditto ..	21 days	6 days		3 days	
3 Ditto ..		3 days		1 day	7 days +
4 Ditto ..		3 days		1 day	14 days +
5 Ditto ..				1 day	7 days +
6 Ditto ..		2 days		1 day	7 days +
7 Ditto ..				1 day	7 days +
8 Ditto ..		2 days		1 day	
9 Ditto ..		3 days		1½ days	

It is seen from the above table that the 4 : 7·2 mixture produces the most stable precipitate. The 4 : 3·5 mixture also gave a very stable precipitate, but a mixture of this composition contains much copper in solution and will probably scorch foliage badly. In each trial the precipitate of the 4 : 4·25 mixture was more stable than that of the 4 : 5 mixture. The last two mixtures are identical in appearance and release a good deal of carbon di-oxide but the precipitate of the 4 : 7·2 mixture is of a deeper blue colour and there is no effervescence of carbon di-oxide.

It was soon found that the time required for crystallisation of a precipitate was really little, if any, indication of the utility of the mixture as a spray. In the first place, the changes which occur to a precipitate when left in suspension in excess of liquid do not occur under other circumstances. With the idea of testing the toxic action of the precipitates on root-hairs various seedlings were placed with their roots in contact with coatings of the precipitates on filter-paper which was kept damp. The precipitate was then in the form of a paste and it was found to retain its gelatinous consistency indefinitely. Also precipitates which were spread as thin films on glass slides, or actually sprayed on foliage, if once thoroughly dried did not afterwards show any visible change even after exposure to the weather. Secondly, if a mixture will give a good covering, with fungicidal properties, when sprayed on to the leaves of a plant, it is immaterial whether the mixture crystallises slowly or quickly, so long as it does not crystallise in less than, say, 24 hours. For practical spraying work, owing to the difficulty of providing vessels for large quantities, Burgundy mixture is always made in quantities small enough to ensure its being used within 24 hours, and usually within only two of three hours of being made. The fact that a mixture will remain in a useful form for a number of days therefore seems to be very little recommendation for it.

The only tests of the relative values of different mixtures appear

to be their covering and adhesive powers, their permanence, their effect on foliage and their fungicidal action as actually tested on fungus mycelium or spores.

The character of the coating given by the mixtures has been tried both in the laboratory on glass slides and in the open by spraying various plants. Drops of a well-stirred 4 : 4.25 mixture spread over glass slides leave a continuous coating when dry. This coating when viewed under the high power of a microscope appears to be colloidal in structure, and shows no crystals or other particles of any appreciable size, but when it is quite dry a network of cracks appears, owing to the contraction of the film. This film does not change in appearance on keeping in the laboratory, on exposure in a moist atmosphere, or even on exposure to rain, though in the last case the deposit is very gradually and uniformly washed away. A fresh deposit also shows in places colourless crystals, presumably mainly of sodium sulphate, left by the evaporation of the liquid of the mixture, but water will readily dissolve these and leave the film of copper compound untouched. A 4 : 5 mixture leaves an almost identical deposit with the same properties, the only difference being that a film left in a damp atmosphere so that drops of moisture condense on it produces groups of insoluble long blue crystals of some copper compound, but the film as a whole appears to be unaltered. A 4 : 7.2 mixture gives a rather less satisfactory deposit, as it is inclined to be lumpy and slightly crystalline instead of forming a quite continuous film. This deposit forms even more blue crystals than the 4 : 5 mixture when moisture condenses on it. The above observations are the result of a number of separate trials which all agreed fairly closely. Whether this formation of crystals of a copper compound affects the fungicidal value of the spray has yet to be determined, but it seems likely that the deposit as a whole will be made less toxic to fungi by the aggregation of part of its copper in groups of large crystals. Moreover, if all soluble matter is first washed off the dried deposit, then no formation of blue crystals occurs when the deposit is afterwards exposed to a damp atmosphere.

Mixtures of these compositions were also sprayed on to gooseberries and potatoes, and it was found that all the different mixtures gave good, almost identical, coatings which adhered well, even after rain. Leaves examined fourteen days after spraying showed no apparent difference between the deposit then and when freshly applied, except that cracks had appeared. No scorching of foliage was found on the potatoes, but in every case moderate scorching occurred on the gooseberries (Keepsake and King of Trumps), there

being no noticeable difference between the different mixtures in this respect. It might be noted here that different ways of making mixtures of the same composition were tried. It was found that it is rather better to pour a fairly strong solution of the copper sulphate slowly into a weaker solution of the soda than to add concentrated soda to weaker copper sulphate or to mix solutions of equal strength. By using the first method of mixing a more lasting gelatinous precipitate is formed.

The fungicidal action of the mixtures was examined in the laboratory and in the field. Preliminary tests of the effect of the precipitates on root-hairs were unsatisfactory but seemed to show that a fresh gelatinous precipitate had more toxic action than a crystalline precipitate. Numbers of tests have been made with germinating spores and it was found that the most convenient spores for this purpose were those of *Cladosporium fulvum* from tomato leaves. By growing tomatoes under suitable conditions a supply of this fungus can be obtained almost all the year round, and the spores germinate readily. The tests were all made in moist chambers on microscope slides. In the first tests the following procedure was adopted:—A drop of the Burgundy mixture was spread over half a coverslip and allowed to dry. Then a drop of water containing *Cladosporium* spores was placed on the coverslip so that half of it was on the plain glass and the other half over the precipitate: this also was allowed to dry and there were then a number of spores adhering both to the plain glass and to the fungicide. The coverslip was then used as the covering of a moist chamber, the spores, of course, being inside the chamber. Usually the spores on the control portions germinated well at ordinary room temperatures, but once or twice in very cold weather the use of an incubator was necessary to start germination. Occasionally no spores germinated even on the control portion of a culture, but when this happened there was never any germination on the sprayed portion, so these quite negative results can be ignored. Considering only the cases where some spores germinated it was found that in every case the spores on the control germinated well, while in half the trials no germination occurred on the deposit and in the remaining cases only a very small number of spores germinated. The same results were obtained with each of the different Burgundy mixtures. Where germinations took place over the deposit it was often found that the germinating spores were floating on the surface of small drops of water which had formed by condensation and were therefore not in contact with the fungicide at all. In other cases germ-tubes were growing into drops of water even though the spores

were apparently in contact with the spray. In order to ensure better contact between the spores and the spray deposit later cultures were prepared in a different manner, the water containing the spores being applied to the coverslip first, allowed to dry, and the drop of Burgundy mixture applied last. In this way the spores were covered by the deposit and contact was assured. In almost every trial of this nature the control spores germinated well, while in no case, whatever the type of Burgundy mixture used, did any germinations occur under the deposit. That this failure to germinate was not due simply to the spores being covered was shown by the fact that spores under similar films of non-fungicidal substances, such as a gelatine-tannin precipitate, germinated well.

Field tests of the relative fungicidal properties of the different mixtures unfortunately yielded no results. A number of plots of potatoes were sprayed, but the *Phytophthora* appeared so late in the season that the potatoes had made much new growth since the spraying was done and became badly diseased in every case.

The conclusions which can at present be drawn from these investigations may be summarised as follows :—The 4 : 7·2 mixture will keep for the longest time in a condition fit for spraying, while the 4 : 5 mixture crystallises most rapidly. The 4 : 4·25 and the 4 : 5 mixtures form equally good coverings when sprayed, but the 4 : 7·2 mixture is slightly inferior. All the mixtures adhere and resist rain equally well, and all are equal as regards the possibility of scorching foliage. Laboratory tests indicate that all the mixtures are equally effective as fungicides, but no satisfactory field tests have yet been made.

Preparation of Burgundy from a Ready-made Mixture.—Copper sulphate and soda crystals finely powdered, thoroughly mixed, and dissolved in water were found to produce a mixture very similar to that made in the ordinary way. The precipitate is perhaps slightly lighter in colour, it changes to the crystalline form rather more rapidly and the coating it produces is not quite so even ; but these differences are extremely slight and a mixture so made appears to be quite as satisfactory as ordinary Burgundy mixture. Such a mixture of powdered copper sulphate and soda crystals cannot be kept, as it very soon begins to cake into solid lumps which are quite unsuitable for the preparation of a spray. If, however, the powdered mixture is made with the appropriate proportion of suitable anhydrous soda instead of soda crystals, then this mixture will keep indefinitely, and when dissolved in water produces a similar Burgundy mixture. A proprietary article, "Blighty," is a powder prepared on similar lines which keeps well

and produces an equally satisfactory spray when simply dissolved in water. All the tests mentioned in the first part of this article have been repeated with these mixed powders, and from every point of view the resulting Burgundy mixtures have been almost indistinguishable from mixtures made in the usual way. The precipitate formed, the coating left on spraying, and the fungicidal properties as tested in the laboratory all resemble those of Burgundy mixture as ordinarily prepared. Here again field trials were mainly without result, but plots of potatoes sprayed late in the season were protected from blight to the same extent as those sprayed at the same time with ordinary Burgundy mixture. The results of trials made with "Blighty" on potatoes in other parts of Somerset indicate that a spray made with this mixture is as effective as ordinary Burgundy mixture as a fungicide. Mixed powders of this kind require to be in a fine state of division in order that both the constituents may dissolve readily, and to be of any practical value the mixture must keep well without caking or deteriorating in any other way. Given these conditions it appears that such a powdered mixture will produce a quite satisfactory spray, and, of course, it is very convenient to use, not nearly so much weighing and measuring being required as when making Burgundy mixture in the usual way. When preparing a spraying mixture with a mixed powder it is important to add the powder to the water slowly, stirring all the time. If a large quantity of powder is added at once there is a great effervescence of carbon di-oxide and the mixture is also of an inferior quality.

Copper Stearate Spray.—An article dealing with the use of copper stearate as a fungicide appeared in our Annual Report for 1917. At that time little could be said about the fungicidal properties of this substance though it had been found to give a spraying mixture with very good covering and adhesive powers. This year further tests of its fungicidal properties have been made. In this case also field trials on potatoes unfortunately yielded no result owing to the disease appearing so long after the spraying had been done. Laboratory trials, however, were more successful. The effect of a copper stearate mixture on the germination of *Cladosporium* spores was tried exactly as described above in the case of Burgundy mixtures. It was found in a number of separate trials that a covering of copper stearate always prevented the germination of spores although the spores in the control parts of the culture germinated well. A spray of this character therefore appears to be as fungicidal as a Burgundy mixture. It is hoped to carry out a conclusive test in the field in the coming season.

**“ REVERSION ” AND RESISTANCE TO “ BIG BUD ” IN
BLACK CURRANTS.**

“ Reversion ” in black currants is marked by one or more of the following characters :—

- (1) The fruit “ runs off,” *i.e.*, at picking time either no berries are found on the string or only a very few undersized fruits instead of the many plump ones of the normal bush. These few berries may be at the base or at the top of the string.
- (2) There is an extensive growth of the laterals resulting in a crowded, instead of an open form of bush.
- (3) The internodes are abnormally long and thin.
- (4) The leaf is sharp pointed, abnormally narrow, with a more than usually serrate margin.

The disease is nearly always gradual in its appearance and frequently parts of a bush will show signs while the rest is quite healthy.

From the practical point of view the failure of the fruit is undoubtedly the most important point, and yet it is probable that the excessive development of lateral growth and the causes leading to it are more likely to supply a key to the problem.

The buds in a healthy shoot of black currant examined in the winter may be divided into two classes, wood and flower buds. It is not possible to distinguish them without dissection, but their structure and subsequent history differ considerably. Wood buds contain a single strong growing point wrapped round with leaf rudiments and occur at the base of the year's shoot and also usually as terminals.

The flower buds are composite, having a central flower rudiment with the two accessory weak lateral growing points. Most of the lateral buds in a last year's shoot are flower buds though their strength varies with their position.

Wood buds usually make a strong wood growth the following year. The terminal wood bud serves for normal extension of the bush while in vigorous bushes a few of the wood buds low down on the year's shoot also push out, thus serving to fill up spaces in the bush.

The flower buds put forth their flower in the Spring, set fruit and then make a short spur-like growth from one or both of the accessory growing points. Under normal circumstances the growth so made is never very long. The result of the evolution of these two kinds of buds is that the black currant makes long and strong terminal

growth, each year's laterals producing at first flower buds and then short spur-like outgrowths. There is not, in a normal specimen, very much lateral wood formed.

From this description it would appear that where in a reverted bush undue lateral wood growth has taken place the cause must be looked for in some exceptional check to the terminal growing point. In growers' plantations it has been frequently noticed that reverted bushes are usually attacked by Big Bud the following year and this fact suggested that there is some relation between the two diseases. At Long Ashton reverted bushes were divided into classes in June according to the virulence of the attack and then examined again in the following winter for Big Bud. This was done for two years and it was then found that the badly reverted bushes were practically always badly attacked by Big Bud the following winter. There is little doubt therefore that the two diseases are closely connected. As to whether reverted bushes get Big Bud more easily than normal or whether mited bushes become reverted is not quite clear at present. Several types of reversion have been observed.

CASE 1.—Associated with moderate or large numbers of Big Buds. Common at Long Ashton.

In this type the terminal is attacked with mites sometime in June. This check may cause out-growth of the lateral buds situated below whose terminals may or may not become mited. If the mite attack is not very strong, terminal growth proceeds normally but the winter terminal bud is found to be a Big Bud. Consequently the following year the laterals below it make an unusual wood growth and the bush becomes filled up with thin wood shoots.

There are many minor variations, according to whether the shoot is strong or weak, or whether the mite attack is strong or weak, but the ultimate result is an undue development of lateral wood shoots.

CASE 2.—Reversion of a Big Bud resistant variety.

Through the kindness of Messrs. Seabrook, of Chelmsford, I was enabled to examine reverted shoots of their "Seabrook's Black" variety. This variety would appear to be resistant to Big Bud in the east of England and yet it reverts.

An examination of such shoots revealed some interesting points. Beside normal buds four other kinds could be found.

- (a) Big Buds containing mite. These were very uncommon and practically always found low down on the shoot.
- (b) Round swollen buds like small Big Buds but containing no mite.

- (c) "Killed" buds, one-third the normal size, much more pointed, with a dead and dried up growing point.
- (d) "Blank" buds. In these cases there was no sign at all of the bud that should have been in the axil of the leaf scar.

Further examination led to the supposition that (a) and (c) were the result of mite attack, (d) were probably, and (b) possibly so.

Killed buds are due to a strong mite attack during the summer on a weak bud. As a result the growing point is killed and thus the mites themselves are starved. The variety becomes, therefore, resistant. This hypothesis was confirmed in the following summer when such cases were actually observed.

If, however, the bud is stronger, as in the earlier formed ones or in general in a wetter climate, the growing point is not killed and the bud subsequently becomes big. The evidence for these assertions may be found in a paper by the Author in the *Annals of Applied Biology*, Vol. v., No. 1.

This will explain, therefore, why Seabrook's Black develops Big Bud in the moister climate of Long Ashton while remaining almost free in the drier climate of East Anglia. The fact that mite attacks Seabrook's Black though it seldom produces Big Bud supplies a possible reason for this variety reverting, always supposing that interference with the terminal bud is a necessary factor.

CASE 3.—No mite or Big Bud present.

Cases of reversion can often be found in bushes where both Big Bud and mite appear to be absent. These cases are very puzzling and no satisfactory explanation can be given. In such reverted material of "Seabrook's Black" it was found that most of the terminal buds were flower buds. Measurements showed that flower buds were only formed at the terminals when growth was moderate or feeble.

In such a bush, therefore, one might have supposed that a definite terminal check would take place the following growing season. There would be no strong vegetative growing point at the apex of the shoot but only two very weak accessory growing points one on each side of the flower rudiment.

For a time, therefore, until one of these accessory growing points had definitely taken the lead and become strong the shoot might be expected to behave as if the terminal bud was a normal one but was suffering from a check. This attempt at an explanation does not, however, fit in with the facts. If a bush be deprived of its normal terminal buds in the early spring it does not revert though it should do so if the check to the terminal growing point was the only con-

dition. What actually happens is that two or three buds just below take up the growth and themselves form new, though weak, leaders.

The lateral buds farther down are not stimulated and the bush resembles in no way a reverted specimen.

CASE 4.—Aphis attack.

Where aphis attacks a strongly growing shoot in summer time the lateral buds immediately below the attacked part become converted into leaders. This process causes the bush to become filled with wood shoots, causing in that way a superficial resemblance to the woody growth in a reverted bush.

CASE 5.—Through unknown causes.

A peculiar form of reversion occurs in very young bushes that have been cut down immediately after planting and therefore cannot be accounted for by any interference with the terminal growth. Instead of making the usual straight growth with broad leaves considerable branching occurs from the laterals made during the current season. The leaves are markedly pointed in shape and the fruit drops prematurely. In such cases reversion occurs before any possible interference with the terminal buds could take place and the explanation must be sought elsewhere. The evidence so far points to these cases being chance seedlings, but no certain conclusion can yet be drawn. With regard to reversion occurring in older bushes there seems to be no doubt that marked development of lateral wood is a concomitant, but whether this is a cause or an effect is difficult to say. It is equally conceivable that some cause makes for lateral bud development involving loss of supplies to the developing fruit as that same cause makes for loss of fruit so that the excess of food is forced into the lateral buds.

X.—ANNUAL REPORT OF THE CONSULTING CHEMIST.

(*Dr. J. A. Voelcker, M.A., F.I.C.*)

Fourteen samples, as against six only in 1917, were sent me by Members of the Society for analysis, during the past 12 months. The list of these is:—

Feeding Meals	...	...	...	3
Refuse Manurial Materials	...	...	...	3
Milk	...	...	...	1
Soil	...	...	...	1
Waters	...	...	...	6

1.—*Feeding Meals.* In the first case a meal stated to “consist of rich nut meals,” and costing £21 per ton, was found to consist mainly of Oats and Barley with a little earth-nut and coco-nut meal, together with a large quantity of weed seeds. It was worth nothing like the price charged.

In another instance a mixture, avowedly of waste materials and used as a substitute for Oats for horses, was found to be not nearly as devoid of feeding value as had been supposed. It consisted, in the main, of grass and clover seed screenings, among which were a few oats, some flaked maize, wheat and barley. It gave 4·23 per cent. of oil and 13·87 per cent. of albuminoids.

In the third case a sample sold as “Feeding Meal” was found to be nothing but Bean Meal.

2.—*Refuse Manurial Materials.* The first was of Town Refuse, taken from a heap of what had been accumulating for a number of years, and so had become much heated and decayed. Speaking generally, Town Refuse is of very uncertain character, owing to the amount of useless matter in it, such as broken glass and china, old tins, etc. The sample in question, however, the analysis of which is appended, was decidedly above the average, and would be very useful, especially on heavy land, in opening it up. It contained quite appreciable amounts of phosphoric acid, lime and nitrogen, as well as vegetable matter, and was by no means wet. Its value, as a substitute for farm-yard manure, might fairly be put at half as much again as that of ordinary dung.

Water	...	...	...	30·20
Organic matter	...	...	...	22·04
*Phosphoric Acid	...	...	...	·89
Oxide of Iron and Alumina	...	...	...	11·78
Lime	...	...	...	3·04
Magnesia, Alkalies, etc.	...	...	...	8·25
Insoluble siliceous matter	...	...	...	23·80
				<hr/>
				100·00
				<hr/>

Containing Nitrogen	...	...	·75
Equal to Ammonia	...	...	·91
*Equal to Phosphate of Lime	...	...	1·94

The other two samples were of mud obtained from cleaning out an old pond. As is usually the case, where labour can be had and the distance the material has to be carted is not great, such refuse is well worth using, especially as a dressing for grass land. The advantage is increased when, as here, the mud contained an appreciable amount of lime. One sample contained 7·6 per cent., the other 17·73 per cent. of lime, reckoned on the water-free sample.

3.—*Milk*. The one sample sent was of good quality and contained Fat 4·25 per cent., solids-not-fat 8·75 per cent.

4.—*Soil*. The sample sent was from grass land that had recently been ploughed up for arable cultivation. It came from Monmouthshire and was a red-coloured deep clay loam, very uniform in character. Analysis of it gave :—

Soil dried at 100°C.

Organic matter and loss on heating	5·75
Oxide of Iron and Alumina	... 10·79
Lime	... .. 53
Magnesia	... .. 1·65
Alkalies, etc....	... .. 64
Insoluble silicates and sand	... 80·61
	<hr/> 100·00 <hr/>

Two points in this analysis are very striking. In the first place the amount of vegetable (organic) matter is distinctly low for newly-ploughed-up grass land, and, secondly, the excess of magnesia over lime is very marked, there being three times as much magnesia as lime. Where such is the case the land will undoubtedly require to be freely limed.

5.—*Waters*. Of the six samples sent, five of them were in pursuance of the question referred to in last year's report, and where complaints of the "furring" up of iron pipes had occurred. In that report I mentioned means of dealing with this difficulty.

The sixth sample was a thoroughly good drinking water containing 15·68 grains per gallon of total solid constituents, and being very free from dissolved organic matter and impurities generally.

The Note-Book.

Agricultural Organization.—English farmers have in the past troubled very little about agricultural organization; but the future success of agriculture, from the point of view of both the farmer's pocket and the Nation's supply of good food at a reasonable price to the consuming population, will depend on the degree in which we succeed in organizing the industry. Of all our agricultural questions, this one of organization is by far the most important.

By "agricultural organization" I mean the *business* organization of the industry; an organization by which the cost of production is reduced to a minimum; by which the selling of the farmers produce is effected on the best business lines and at the lowest cost; by which the whole commercial side of agriculture is directed by the best commercial brains that money can procure, and no one is engaged in it who is not needed, while everyone who is engaged is efficient; so that the industry shall not carry on its back any superfluous profit-takers. Under such a system the farmer can devote his whole time to his farm and leave buying and selling to men with commercial training who understand the job better than he does; who yet are so employed and paid that the farmer's interest is their interest. Every great manufacturing industry is organised to-day in this way. World competition would be impossible without it. English agriculture alone remains imagining that it can do what no other industry in the world can do.

Organization is not a side issue—though I fear that many farmers still so regard it—but the life-blood of the industry.

Let us take a general survey of what English agriculture was before the war and what it is likely to be after the war: and sum up the leading characteristics of the old age and the new.

There are two features which stand out more clearly than any others in the picture of what British farming was before the war. The first is that the Nation took little interest in it, and consequently the State neglected it completely. With the exception of an Agricultural Holdings Act, the tenant-farmer took little change out of the politician. To help the industry as a whole, because the nation needed it, never occurred to a British Government.

The other feature is to some extent the natural corollary of the

first ; the complete freedom of the farmers and their independence of Government control.

How much was there of good and how much of bad in this state of affairs ? Freedom is good ; and I believe it to be absolutely essential to the welfare of this country, in the highest sense, that our farmers should remain a race of really free men, earning their livelihood on their own farms, taking their own risk, and making their own profit. They have been the backbone of the nation during the war, whether in the trenches or on their own fields. The preservation of their freedom is one of the first duties of statesmanship. So far so good. But our farmers have perhaps a little overdone the spirit of freedom. They were so independent in character that they insisted on being independent of each other, and were unwilling to enter into that effective combination, so essential for business strength. Each farmer was like a cyclops living alone on his own farm ; suspicious of his neighbour ; resenting help lest it should become interference ; often unwilling to learn new methods, and usually contemptuous of science. Our experience during the war makes us almost shudder when we hear the words " State control," and there is a temptation, when we look back to the State's indifference and aloofness, in those far-off days before the war, to think of it almost as an elysium : but second thoughts remind us of the tragedy of the last two decades of the nineteenth century, when the low prices of imported cereals, dictated by the competition of virgin soils and low ocean freights, made it impossible for the English arable farmer to meet the losses ordinarily incidental to bad seasons and so ruined many of them.

This is the other side of the medal, and freedom from State interference can be purchased at too high a price if it means that the industry cannot be carried on at a profit.

What are the leading features of the new age ? At present the public is watching every movement of the farmers. Why ? Because the nation through the war has learnt what it was too stupid to understand before—viz., that a productive agriculture is essential to its security, and, possibly, to its existence. The majority of the public see that we nearly lost the war through the German submarine, and that for the future we must be in a position to feed our population—or most of it—on home-grown food. In other words, the State henceforth will regard itself as having a direct interest in agriculture. I believe that the days of State indifference have gone, never to return ; that, whether we like it or not, farmers will never again get the complete freedom which they had before the war. State control in some measure has come

to stay. Whether the kind and degree of that control will be tolerable or intolerable will depend on the farmers themselves. To make it tolerable two things are necessary. First, that they should produce the amount of food the nation wants, of the kind it wants, at the price it wants. Second, that they should combine together in an organization which will be strong enough to insure that they are treated with justice and that the politician does not make impossible demands upon them. While the public has realised the importance of home production, the great consuming population of the country does not as yet understand the difficulties of the farmer nor the cost of production, nor does it care overmuch about his making a reasonable profit. Prices have been regulated during the war, and price-regulation in a democracy is a little bit like the drug habit—it is apt to grow on people. And the newly enfranchised ladies may care more about the price of milk, and bread, and meat than about what it costs to produce them. In the future, as in the past, there will be unscrupulous politicians who will attack the farmer in order to please the urban voter; and maximum prices and nationalizing the means of production are sure to be prominent planks in their platform. Excessive State control, then, is one of the chief dangers which the industry must anticipate and take means to avert.

Another outstanding feature of the new age is to be found in the fact that leaders of commerce and industry have discovered the possibilities of good business both in farming and in farm products. Farmers, if they are not careful, may find their birthright taken from them. Capitalists are investing money in farming because they see that money is to be made by farming on big lines: in other words, by organization. The small shopkeeper has in many trades been supplanted by the large multiple shop. Multiple farming has begun in this country on the same lines. A commercial company appoints a skilled manager and runs as one concern a number of separate farms, on each of which there was once an independent farmer, who is now just a foreman. Sir Daniel Hall has made us familiar with the idea of the very large 5,000 acre farm. Of "commercial farms" of this sort it is well that we should have a few. It is one way whereby the farming of the country can be made more efficient. If it were the only way, economic pressure might force us to adopt it generally. But the drawback of it is that the nation would lose its race of independent farmers, who stand for so much that is strong and good in the fibre of our national character. And it is not the only way. I am convinced that by organization on co-operative lines—i.e., through agricul-

tural co-operative societies—most of the advantages of the large commercial farm can be attained without sacrificing the independent farmer.

Is the farmer's birthright only farming? Why should he lose all control of his produce at its very first stage—viz., that of raw material? Why should he not follow it through its later stages till it reaches the consumer, and so share in the greatly augmented price that the consumer pays, at the same time he might benefit the consumer by reducing the intermediate costs of manufacture and distribution, and so let him have his food at a lower price than before? The farmer grows the wheat. Why should not farmers join together and do the milling, and retain the offals of their own grain?

To-day they sell live stock to the amount (on pre-war figures) of over £50,000,000 a year. Why should they have no share in the fresh meat trade or in the valuable by-products of the slaughter-house? Again, take milk. How much of its profits go into the pockets of the farmers? It is one of the elemental truths of industrial competition that the man who controls the raw material controls the manufactured article. Every American manufacturer knew it long ago. And now the war has taught it even to English manufacturers. Why don't farmers combine together and take business-charge of their own business—at least of their own wholesaling—even if they don't do the manufacturing or retailing? There is literally only one obstacle in the way, and that is unwillingness to improve their own business position.

It is not only from the ordinary capitalist that the capitalist danger can be discerned. The small consumer has become a capitalist in these days, and he too is having a slice at the farmers' birthright. There are some 12,000,000 industrial co-operators. They are all consumers, and they are coming into agriculture as producers. In the "Co-operative News" (which is the paper of the movement) for the 7th September last it is stated that the Co-operative Wholesale Society—which has a huge capital—now owns 45,000 acres of land, including over 5,000 acres recently acquired, in regard to which they say that "the land will be used to develop a co-operative milk supply, and will constitute part of what we hope will ultimately be a huge system of co-operative dairy farms." The industrial co-operative movement has been of great benefit to this country, and there should be no hostility between it and agricultural co-operation. On the contrary, there is ample scope for cordial relations and mutually beneficial inter-trading between the two movements—on very large lines. Nor do I think that farmers

should resent the acquisition by the C.W.S. of land for farming. In the unorganized condition of British agriculture and the absence of any organized policy of supplying the consumers' societies direct with the food they need at reasonable prices, the leaders of the industrial movement naturally turned to the acquisition of their own farms.

I think we may now sum up the chief features of the new age of British agriculture in one sentence. The State, the capitalists, and the consumers all have it in their mind to control the farming of the country. On the other hand, it is in the real interest of the nation that the farming class should be preserved as a distinct class in the community, and that they should continue as free men, and not become mere salaried bailiffs. There are many convincing reasons for that view ; though perhaps I need not elaborate them. But if farmers are to be kept alive—and in sound health—for the nation's benefit and their own, they must do two things. Firstly, satisfy the State and the consumer by meeting the requirements of the population as regards quantity, quality, and price. Secondly, run their business efficiently, or it will be taken from them by the man of business. There is only one way in which this can be done, and it is by organization.

I have approached the subject from the point of view of the industry as a whole, because it is only by considering the general trend of the times that the absolute necessity for organization becomes clear. The big farmer knows that as well as being an expert in production, he is no mean hand at the commercial side of farming ; and he is naturally inclined to say, " What am I to gain by co-operation ? "

My first answer is that he can gain by co-operation (which is only one form of business combination) just what every big concern gains by joining with other big concerns. The new combined whole is greater than any of the individual businesses, however big they were. Why have some twenty leading banks of the country recently amalgamated so that now there are only five ? Not because the twenty banks were each of them inefficient ; but because their efficiency, great as it was, is made greater still by combination. Farmers have often talked of organizing, and the National Farmers' Union is an excellent organization of its kind ; but it will never have the power of a trade organization for the very simple reason that it has not a large capital at its disposal. It is plainly, then, to the interest of the biggest farmer to take the lead in the campaign for organization upon which the salvation of British farming depends.

But there is another argument, and one that will, I think, appeal to big farmers. The small man depends infinitely more for his success in life upon effective organization than the big farmers, and the latter can render him invaluable help by throwing in their lot whole heartedly with the cause of agricultural co-operation. No man who farms less than 300 acres can be called a big farmer, yet only three out of every hundred farmers in this country farm more than 300 acres; only thirteen farm more than 150 acres; and only half farm more than 50 acres. England, then, is a country of small farmers; Wales still more so; and the big farmers should extend the disinterested hand of help to all those small men. Indeed, I put it frankly as a question of duty. The big farmers can help organise the whole farming community of this country, and thus render a great service to the Nation.

There is a side issue, closely affected by our subject, which is very dear to the hearts of all of us, and that is the returning soldiers and sailors after the war. I was a member of the committee appointed to consider their settlement and employment on the land. The committee was unanimous in thinking that it was most important for the smallholder to belong to a good co-operative society, and doubly so if he came to his smallholding without much previous experience. It is difficult to prophesy, but I believe that many soldiers who were not engaged in agriculture before the war will want to take it up when they return, and it will be an immense gain to the Nation if they do. In order that they may learn something of their profession—for the life of a smallholder is both hard and difficult—they ought in the first instance, if possible, to be employed as labourers on the farms; though the experience of inefficient labour which farmers have recently had will not make it very easy to get untrained men taken on. But the prospect of a smallholding in later years and of making a reasonably good living out of it is a great incentive to hard work, and it will make these men learn their work on the farm much quicker and better if they can rely on getting in the future, when they pass on to a smallholding of their own, all the help that a completely organized system of co-operative societies alone can ensure.

Having dealt with the general reasons in favour of organization, I want to show what it means in practice. With the general idea of a co-operative society most of us are familiar. Experience has proved that it is not much use attempting to transplant a particular kind of society that does well in a foreign country. Thus, in Denmark, there are a vast number of small societies, each for one type of business. Here in England and Wales we have found that the

kind which serves our needs best is the large society—covering a considerable area, and conducting more than one type of business.

There may be several sides to such a society's work. But *buying co-operatively* for its members what they want and *selling* for them what they produce are the two chief ones. And of these two, it is easier to begin with the buying side; and most of our successful societies have begun by the purchase for their members of farm requirements, such as fertilisers, feeding-stuffs, seeds, implements, and so on. As a general rule (and we need not trouble about the exceptions), there is nothing a farmer buys which cannot be bought better if bought through a co-operative society than bought by the farmer individually. The rule is of general application, and not confined in any way to a farmer's business. If you want to buy efficiently, you must go to the best sources of production. You can only do this if you can buy in sufficiently large quantities; and you can only get the best price if you are a customer whose custom means a very great deal to the seller.

One thing more. The man who buys for you must be a first-class buyer; and if you have to purchase different kind of articles you must be able to command the services of a first-class buyer for each kind of article. Your seeds buyer wants a different scientific and business training from your machinery buyer, hence, if you are to employ different men for each class of requirements you must have enough trade to afford the salary of a good man in each line and to keep him continuously busy. For this purpose combination on co-operative lines can be made just as effective as combination on joint stock lines. It is obvious that a thousand farmers bulking their purchases of fertilisers and placing one order can obtain better terms than any one of them could obtain by himself. This they can do by joining a co-operative society and employing a manager who understands the fertiliser trade.

But you may say that whilst an average 1,000 farmers joined together in a farmers' trading society might afford one manager and a couple of sub-managers, they would not have enough business in each separate line—seeds, feeding-stuffs, fertilisers, machinery, etc.—to make it remunerative to employ an absolutely first-class man for each department. I agree. But assume that the society of 1,000 farmers joins with ninety-nine other societies of 1,000 farmers each, so that we have 100,000 farmers in farmers' trading societies, if all these societies combine together for the purposes of joint buying and run their own wholesale society, they can send to it the bulked orders of their various members; and the wholesale society, now having behind it this combined volume of trade can

easily afford to employ the very best men in each line ; command the very last discount from the manufacturers and import whole cargoes on the very lowest c.i.f. terms.

And if 100,000 farmers can thus join together and win such a commanding position, what is there to prevent the 423,718 farmers, returned in the last annual Board of Agriculture statistics as the total number of farms in England and Wales, from joining together in the same way and thus controlling every ton of the farmers' buying market in this country ? There is only one thing in the way, and that is the slowness of the British farmer to see his own interest. Provided my premises are sound, farmers can command the position absolutely if they will only join together.

So much for the buying side. Though less has been done as yet by co-operative societies on the selling side, it is in the long run the more important of the two. I have already given, the reason, viz., that it is only by concerted action you can retain control of what you produce in any one of its later stages. Yet in wholesaling, manufacturing and retailing there is as much money to be made as in the production of the raw material.

Direct profit is not the only gain. Supposing the bulk of the wheat crop were disposed of through your co-operative organization, you would not only make sure that each farmer got from his own society the full price that the quality and condition of his grain justified—and it often happens that the manager, who is a grain expert, will give a member 2s. or 3s. a quarter more than he has been offered on the market—but your wholesale society would make it a condition of its sale to the millers that they should return the whole of the offals. You would thus kill two birds with one stone, selling your corn and making sure of your feeding-stuffs, and the millers would know that if they were not reasonable the capital resources of the Farmers' Wholesale Society would enable you to start milling on your own account, just as the C.W.S.—the wholesale society of the Industrial Movement—does to-day.

Up to now, although a good deal of corn is sold through the societies, more has been done on the selling side in milk than in other produce—probably because the advantages of common collecting, cooling and selling are peculiarly obvious in the case of milk ; and the milk depot readily lends itself to the manufacture of cheese and other milk products in the flush season. This summer our dairy societies have been dealing with about 150,000 gallons of milk daily.

With fruit and market garden produce co-operative selling has made good progress for the reason, as everyone knows, that fruit

must be well graded and packed to sell well. Indeed, the Americans say that "a well-packed article has already sold itself!"

Poultry and egg-collecting and bacon-curing are other subjects of co-operative activity. During the last twelve months co-operative slaughter-houses have been started. We have five of these in full work now. There is no reason whatever why, if the farmers will only make up their minds, they should not have just as big a meat business—with all its valuable by-products—as any packing-house of Chicago.

The extension of the buying side of co-operative trade will make for better farming by insuring good quality in feeding-stuffs and fertilisers, for every society will see to the analysis. But the level of farming can be raised in other ways too. A State or county expert adviser is now looked on a little bit askance by the ordinary farmer—probably because of a feeling that the official expert has no direct interest in the pecuniary results of his advice. But if, as a member of a co-operative society, I voted for the employment of an expert by the society, I should at once feel that the man was my servant, and that my interest was his interest, and be glad enough to take his advice. Through the societies a much more intimate relationship could thus be set up with the system of agricultural education in the county. In farming the lesson that really teaches is the object-lesson: seeing is believing; the difference before your eyes of a crop grown in the right way and one grown in the wrong way is convincing. So are properly kept milk records of a good dairy herd. Why should not societies arrange for demonstrations in cultivation, dairy records, cost accounts, etc., on the farms of selected members in different parts of their district? This would solve the difficult and pressing problem of demonstration farms.

Another need of British farming can be met by co-operative organization, and that is the supply of adequate working capital for the small man. The big farmer can get it from his bank easily enough; but the small man cannot. Yet the personal credit of the keen, hard-working small farmer who means to get on is about the best security in the world. If he will only buy his requirements from his society and undertake to use them on his farm, the society can advance him a loan at interest, and he can get his full bonus for a cash purchase: and his society is perfectly safe. This is the credit scheme which the A.O.S. have adopted, and Lord Selborne's Agricultural Policy Committee have approved of it in their report (Cd. 9079). We hope, with the help of the banks and our wholesale society, to get it into working order at once.

There is hardly any department of the industry where co-operative organization would not bring advantages. Take, for instance, the question of labour. Economy in labour is of the highest importance. Much could be done by spreading farming operations over the year on Mr. Wibberley's system of farming on factory lines: but, apart from that, the chief saving is to be looked for from labour-saving machinery. The small farmers of the country cannot own much of it, or, if they do, cannot give it remunerative employment because it will be lying idle too long. If they want it, they have to hire it. Which will be the cheaper—to hire it from a contractor or for their own co-operative society to own it and hire it out to them? Why should not machinery, with expert labour attached, be regularly let out on hire by the co-operative society to its members?

Or, take the question of live stock. Why should not the society own bulls, stallions, boars, etc., and let them out on hire? The use of inferior bulls is a curse of British farming. We all know how much the milking herds of the country could be improved.

Such is the general policy of the Agricultural Organization Society. The membership of affiliated farmers' societies to-day is about 60,000 and of allotment societies about 70,000, and the total turnover about £8,000,000 sterling: a small proportion of the whole, I agree, but still substantial and rapidly growing.

An agricultural co-operative society formed in the interest of all farmers of the district should embody the following principles in its rules:—

1. Membership should be confined to cultivators of land.
2. Capital should be found by the members.
3. Interest on capital should be limited to a reasonable rate, say 6 per cent.
4. The total issue of share capital should be unlimited, so that shares should not enhance in value.
5. Balance of profits should be distributed amongst the members in the form of a bonus on business done through the society.

A society on these lines can be registered for a sovereign, and will not be subject to payment of income-tax. It is the only form of combination which will make certain of *all* the profits from combination accruing to those in whose interest the combination is formed.

Small societies are not desirable as a rule. Efficiency is immense-

ly promoted by having a strong society covering a fairly large area and combining all the various functions referred to. It is only by doing business in a fairly big way that the society can afford to have the best head manager and managers of departments, and can do its work at the minimum of cost in proportion to turnover.

It must be borne in mind that agricultural co-operative societies do not, like joint stock companies, lay themselves out to make profits; their main object is to supply their members with the best goods at the lowest price. They must, however, allow sufficient margin in their prices to cover trading contingencies, and the profits, if any, arising out of this margin are distributed in the form of bonuses.

Large as well as small farmers belong to our societies. The average area farmed by members of the Eastern Counties Society in 1917, with its 1,800 odd members (since increased to 2,400), was over 250 acres.

The *Agricultural Wholesale Society*, which the A.O.S. has helped to get into order is now in full swing at 48, Mark Lane, next to the Corn Exchange. A reasonable scale of share capital for societies joining it has been agreed to (£1 per member plus 2 per cent. on turnover for farmers' societies, and 1s. per member plus 2 per cent. on turnover for allotment societies), and as its usefulness becomes apparent it will be easy to increase its capital.

The directors are elected by the societies, and there are sectional boards—farmers, trading, dairy, allotments, etc.—elected by the societies in each section, so as to make sure that each department is directed by men with special knowledge, subject only to the control of the general board. The A.W.S. is already making and repairing dairy churns, and has two expert dairy engineers in whole-time employment.

The duties of the Agricultural Organization Society are to help the farmers, small holders and allotment holders of the country to form themselves into co-operative societies on sound lines, and to help these societies with expert advice in various ways and get them new members after they have been once started. The cordial relationship which has been established between the allotment holders affiliated to the A.O.S.—and there are now about 70,000 of them—and the farmers is one of the best bits of work the A.O.S. has done for the future of agriculture in this country. The A.O.S. has been re-organized this year and put on a purely democratic basis. A great majority of its Governors are now elected by the farmers' societies in the fifteen branch areas into which England and Wales have been divided; and each branch has been given a

large measure of local autonomy under its local committees elected by the societies trading in the branch area.

In addition, the A.O.S. branch committees are to act as local advisory boards for the A.W.S. The whole movement is therefore now democratic. The farmers' organization is run by the farmers for the farmers.—LESLIE SCOTT in *Farmers' Club Journal*.

A Revision of Breeding Methods.—The time seems to be coming in the near future when the Government will exercise a far greater power than hitherto in the matter of live stock breeding. The Board of Agriculture's live stock scheme is on a very firm foundation when it seeks to increase the keeping of authentic milk records and to enable good sires to be placed at the disposal of small farmers for the purpose of grading up their stock. However, it must never be forgotten that private enterprise and skill have enabled these schemes to be possible for they provided in a high state of perfection the materials with which to work. Now the proposals put forward in some quarters for a general Government control of live stock breeding by using licensed sires would in effect revolutionise the stock breeding industry. In many ways the present methods have much to commend them; yet no one can deny that a system of licensing would place Britain as a live stock country in an even superior position to that which it occupies to-day. As to what form a system of licensing would take we have a very limited idea. In the case of stallions we are told they are to be passed for soundness. This is a very desirable thing, but how often do the opinions of veterinary men come into direct conflict on this very point? As an instance of this, one has only to note the "spinning" of a young stallion at the Newmarket Hackney Show, which several other veterinary surgeons afterwards certified to be sound. There is another example in the writer's own experience, when a horse sold at Peterborough was turned down for side-bone by one vet., and certified as sound by another. There ought to be no excuse for using an unsound stallion to-day, when most of our leading Breed Societies—and these represent the individual breeders—do not deem an animal worthy of any prize or honour if it is not sound, and, what is more, there is no lack of famous horses as a result. The sire is in a different position to the dam, being able to influence such a large number of progeny, and the pre-disposition to certain diseases in the offspring of an unsound sire is an undisputed fact. It is unfortunate that the need has arisen for supervision in this direction, but it will have a very desirable effect, for in many cases the unsound sire is the cheap one.

Turning to the world of cattle, one wonders what will happen here. There has been a great deal of inconsistency shown on the part of some breeders. We find that it is possible by a constant process of selection to build up a strong herd of dairy cattle from most of the existing breeds. But, on the other hand, how often is the sire used responsible for causing a decline in the annual milk yield? There is certainly no more difficult task facing any breeder than that of choosing a fresh sire to head a dairy herd. It is not always safe to brand a bull of the "beef" type as being useless in this direction, neither is it wise to rely upon "dairy" characteristics solely; there is a superior and safer method, and that is to select the bull on the merits of his sire and dam. In the last few years there has been a boom in the Cumberland and Westmorland cattle for their dairy qualities, and there is no mistake that when these cattle are bred true to type they are excellent both for filling the pail and the production of beef, combined with a hardy constitution. As a result of this, the Penrith district has become a great centre for the sale of bulls, but it is surely a grave mistake to think that every bull of merit bred in Cumberland or Westmorland is fit to go into a herd of dairy cattle. Authentic records as to the achievements of the dam's and sire's family at the pail, alone will settle one of the chief problems which must be at the back of every dairy farmer's mind. It has been too much the custom in the past to buy the dairy bull on the dam's record alone, but it should not be overlooked that the sire is equally responsible. The horse-breeder in buying an animal invariably asks first and foremost about the breeding of the sire, but too often the cattle-breeder is satisfied by an inspection of the dam alone, and this is a point which demands the closest attention of every breeder. Having once secured a bull possessing desirable qualifications, it is not too much to urge that he should be kept alive until his progeny come up to calve. The proof of his worth would then be apparent in the udders and milking capabilities of the heifers.

There has been far too little attention paid to the use of mature sires in our herds. The common practice is to buy a bull as a yearling, use him for about three years, or even less, and then send him to the butcher. This system has been much in evidence up till quite recently. It has been responsible for much evil, for by this means some very valuable sires were lost to the country every year. How often has regret been caused to the breeder of dairy cattle when the progeny of a certain bull, now dead, gave excellent returns. Unfortunately, our best-looking and highest priced animals do not always give the best results, hence there is an urgent need for

judging the value of a sire upon his results. Perhaps the surest means of effecting this is for a more extensive use of mature and proved sires in our herds. A bull is quite capable of getting strong, healthy calves up till eight or ten years of age at least, and, if anything results go to prove that the mature sire begets the best animals. There was no more ardent believer in the value of the aged bull than the late Mr. R. Nicholson, of The Gilt, and the innumerable winners in the Dairy Shorthorn classes which were bred in his herd serve to emphasise the beneficial effects resulting from such a procedure. One of the most undesirable features in a frequent change of stock bull is that the herd tends to lose any uniformity of type which it may possess, while on the other hand, there appears to be little doubt that a certain amount of close breeding tends to fix type very materially. One family in the Dairy Shorthorn world, viz., the Maggie family, boasts of an initial pedigree like this :--

4d. Maggie 5th, by Baron Barrington 4th 33006.

5d. Maggie 4th, by Duke of Holker 33153.

6d. Maggie 1st, by Baron Barrington 4th 33006.

Members of this family are not only exceptional milkers but they are also possessed of a certain grandeur of form whereby a Maggie can be readily picked out from the other members of the herd. The above pedigree also shows that Baron Barrington 4th cannot have exercised any injurious effect on the family, and the second time his name appears he would be an old animal.

From this it would appear that there are many points which call for revision in our breeding methods, and there is great hope for experiment in this direction.

Unfortunately, the sheep is outside the scope of the present live stock improvement scheme. Nevertheless, there is plenty of need for revision in this branch. It has become very evident that in some breeds the demands of fancy have entailed serious losses, and breeders, in their endeavours to regain what they had lost, find they are outclassed by other breeds. No matter what the breed is, constitution should be the primary consideration, because it is only from sheep with sound frames that the best results will be obtained. The choice of a sire is, therefore, of equal importance with this as with any other class of stock. Too much reliance should not be placed upon the use of a lamb in a flock. Often the forward lamb which carries away the prize is disappointing as a shearling, and, generally speaking, one can judge the value of a shearling better than a lamb. Still, the Suffolk breeders claim that

the use of ram lambs encourages early maturity ; and, whether this is so or not, early maturity is a very desirable property, and the evidence seems to point to the fact that late maturing sheep are products of the past.

If a breeder, be it of horses, cattle, sheep or pigs, would make progress, he must be alive to the value of sound animals in every sphere and with these as a foundation he is quite able to build up his types as he chooses.—HENRY ROBINSON in *Live Stock Journal*.

Science.—The war has made us see many matters in a new light, and especially as bearing on the relations of nations. The world strength and influence of a nation is not measured alone by its wealth and commercial resources and force of arms. Its position in science as an original source of knowledge and a leader of thought and progress is an element of no small importance in giving it authority and commanding respect. Conspicuous activity in science not only advances a nation internally as a direct result of its accomplishment and its broad influences, but it is one of the important elements in determining the rank of a country among nations and respect for its views. It is one of the elements that make for pre-eminence.

A nation which can control the principal avenues of scientific communication between nations and continue to supply the leading hand-books and treatises through a long period has at its disposal an unusual opportunity for presenting its views, and securing prominence for them ; thus exercising a profound influence on current science and theory throughout the world. Such position gives it a kind of power which is more looked up to and acknowledged in time of peace than is its potential force of arms. This we have well seen.

A contest for supremacy does not stop with such boundaries as territory, trade, and allegiance. It recognises the advantage of influence and leadership, as well as of absolute authority. It naturally seeks to retain that advantage, to dominate world knowledge, to be regarded as the Nestor of science, to propagate the view of its pre-eminence in that field and of the authority of its outgivings.

To gain a commanding authority in science is not less to be sought than power in other directions, and it is quite as potent as a means of elevation. This is clear from the recognized dependence upon science of progress in industry and human welfare. A people who can dominate research and scientific thought can in large measure influence human development, industrial and intellectual.

They become masters in a large sense, with power to exercise a control through the forces of influence, competition, priority, and leadership.

Authority secured through pre-eminence in science implies a dependence and inferiority or backwardness of those brought under it which inevitably restricts national development and independence of thought. This is true without the exercise of any oppressive or restraining measures. No progressive country can long forge ahead in its development and keep pace with the nations of the earth if it depends on borrowed or transplanted science. It must itself be an active and effective contributor, for it has its own special problems which it cannot wait for other countries to solve. It must develop competent specialists and experts capable of acquiring as well as of adapting and interpreting.

This is peculiarly the case in agricultural matters. Not only the proper applications of world knowledge need to be determined by careful study with reference to the local situation, but fundamental inquiries must be fostered which reach out into the unknown, or progress will be held back. Much of the task of scientific development in agriculture depends upon activity of this nature. No country can afford to be dependent upon another for it. If it is, it will necessarily lag behind and it is likely to make many costly mistakes.

It is recognised, of course, that science is not restricted by any national boundaries. It is world-wide, free, and its acceptance and incorporation into the knowledge of a nation is restricted only by the avenues of communication and the attitude of its people. But the provision for scientific investigation and publication should be a national one, since it is a matter of national interest and life and growth. Second-hand science is tardy, and does not take the place of original work. It develops neither the spirit nor the forces for investigation. These are national assets and largely of a nation's making. The pursuit of research lends a certain element of zealous competition and pride in the scientific advance of one's own country.

The power of knowledge has been given remarkable demonstration by Germany. Her science in agriculture has alone enabled her to wage four years of warfare cut off from the rest of the world as effectively as possible. All of the principal countries opposed to her have acknowledged her superiority in acquiring and incorporating in practice information based on research, which has made her agriculture in many respects the best example of scientific agriculture in any country. The influence of her teachings and her example has been unparalleled.

In this country we have frankly acknowledged in the past that much of our agricultural science was borrowed from other branches and other countries, notably Germany. For a long time German-made science and German-made theories relating to the principles of agriculture and their practical application dominated all others. They gradually assumed a degree of authority which it has been difficult to overthrow even when our own work has shown them not to be applicable. The extent of the activity and the leadership of the country in this field, and the authority with which they were set forth, led contributions and theories which emanated from its workers to be readily accepted and regarded as representing the last word.

The situation was further emphasized by the fact that the results of this outstanding activity in research and discussion were reported in the standard journals of that country, which were frequently the leading journals of science in the world. German scientific literature was long the most important means of communication, and maintained its supremacy in spite of being in a difficult foreign tongue. It tended to make the German language the language of science. The theory and principles developed out of this investigation were promptly embodied in treatises and handbooks which by reason of the painstaking care in their preparation and frequent revision have remained standard for a long period, and even in their translation have retained the influence of their origin.

These circumstances, together with the historical development of agricultural science and the striking examples of its application, operated to give German science a pre-eminence in agricultural theory and practice. For a long time at least it dominated opinion, and investigators were slow to controvert it or to secure the acceptance of diverse opinions. Witness the tenacity with which Wolff's feeding standards were accepted, even though they were based on infinitely less data than were represented by the many tests of them. The question of nitrogen assimilation from the air was a hotly disputed point, despite the experiments of Lawes and Gilbert in England, Atwater in America, and others, until Hellriegel reported his important findings which have been stamped as classic and accepted the world over. In all research the deriving of conclusive evidence is of prime importance, but the courage and force of the investigator's convictions and confidence of his audience are only secondary.

Despite the great influence German methods and results have rightfully had on our own agricultural investigation and deductions, it is important that we should not subordinate our activities or be

tied to theories and impressions of the past. While it is difficult to shake off the influence of German science upon our work and theories and upon the public mind, and this is only important so far as it impairs our scientific freedom, the solution of many of our peculiar problems requires a measure of independence and self-confidence which are now warranted.

Results and conclusions need to be assessed at their real value and significance as judged by the light of our own standards and conditions, irrespective of the source. With a disposition to accept without prejudice the results of applications of investigation which fits our conditions, it is important to exercise independence of thought and criticism, and to develop a measure of self-reliance commensurate with our own opportunities and vast needs.

The scientific activity of this country (America) in matters relating to agriculture has grown tremendously in the past 20 years. It may be well for us to recognize frankly that in a considerable number of lines more work of an original and epoch-making character is being done here than in any other country, and that this places us in a position where we need not be dependent on others for the method and the fundamentals if we exercise the full measure of our opportunity. In a number of conspicuous lines, workers in this country are doing as high grade of investigation and on as large a scale as in any part of the world; and in some lines it is probably not too much to say that they are in the lead. This is a reason for confidence and an indication that it should not be necessary to wait upon other countries to do the pioneer work for us in research or application.

A great deal of American research has now gone beyond the views current abroad and has entered the field of original inquiry. Some of it is at variance with teachings we have accepted in the past. This is no stricture, for we need theories and hypotheses as means of advancing knowledge from point to point, and some of these will inevitably be relegated to the rubbish heap; but the danger lies in following, somewhat blindly from force of habit, and accepting deductions and applications made under a quite different set of conditions. Interpretation is no less important than acquiring the fundamental facts. Because agricultural science is a composite science, and largely an applied one, research and especially interpretation and generalization in it need to be made with great care and with full understanding of prevailing conditions.

Not all of our borrowed or transplanted science has been found to apply. Theories and conclusions in which great confidence was placed because of their source have been woven into the fabric of our theory and principles and urged in practice only to be found

later not wholly applicable under American conditions. Modifications have proved to be necessary, sometimes even extending to the basic principles. This is doubtless partly our own fault, but it indicates the danger of accepting and applying unquestioningly work from another source and holding to it tenaciously after our own experience has cast doubt upon it.

Illustrations of lines in which American workers are conspicuous and are in some instances in the ascendency are found in such subjects as the study of the principles of breeding, the chemistry of the various constituents of foods and feeding-stuffs and their special nutritive relations, the study of diseases of plants and effective means of combating them, the control of insect pests based on life history studies, the theory of the action of sprays and other remedies, and the functions and relations of water and fertilizers in plant growth, etc. In these and many other lines the force and the faculties have been developed, and in large measure the support which makes their continued pursuit possible with public funds.

If therefore in some of these matters a point has happily been reached where we can more largely stand alone, and where our investigators have become leaders and not followers, there is the more reason why this position should be maintained and extended. There is no reason why we should be dominated or overshadowed by the knowledge and science of another people. The intellectual independence and the development needs demand that we shall be scientifically fit and maintain our research in the front rank.

We recognize the international character and spirit of science. It is a neutral subject. We accept the new contribution on the basis of its actual merit as nearly as it may be assessed, without respect to its source. But it is well to remember that there is no hierarchy in science, no single source or group to which it is committed or to which we are to look for it. Theory and discovery are not necessarily worthy of more weight because they come from a source which has furnished our most conspicuous supply in years gone.

In the new world which will exist after the war the United States, as a member of a fraternity of nations, ought to contribute to the advancement of human knowledge in proportion to its population and wealth. The object will not be to gain knowledge for the purpose of dominating the rest of the world but for the sake of making our proper contribution to human welfare. We are fortunate in having established a great system of agricultural research on a public foundation and largely connected with institutions for higher education, thus keeping it apart from political and commercial influences.

We have come to realize already some of the advantages to this country of its present position in agricultural investigation and of the means of dissemination provided by treatises and periodicals in our own tongue. It is quite possible that after the war scientific journals and handbooks in the English language, if maintained at sufficient grade to merit it, will find a wider market and a wider field of influence. We are now able to see that the advantage of pre-eminence in a line of science lies not alone in its benefit to the industry for which it is primarily developed, but in the prestige it may carry among men of science and in the family of nations.

EDITORIAL LEADER in *U.S.A. Experiment Station Record*.

Production and Property.—A Lecture by Mr. John Orr, M.A., Oxford.

There is this disadvantage attached to the discussion of questions in economics, as compared with those in chemistry and botany, that it almost inevitably arouses personal feeling, because it deals largely with personal activities and not with the activities of material and impersonal substances. Such feeling is apt to obscure the full situation in proportion to its strength. There is nothing with which men have so much difficulty in working as with other men. They may grumble at soils, manures, seeds, and the weather, but they know it is no use to call them names, or to take them into the law courts. They must accept those things as they are, and do with them what they will do, and the less they say about their faults, and the more they do to mend them, the better they succeed. It has taken much discussion and a vast number of experiments to decide the best methods of handling soils, manures, and seeds, in order to get the best crops. That work is not yet finished. It will probably take more discussion and as many experiments to determine the best methods of handling men, in order to get the best results, and certainly scientific work in this connection has not yet been seriously undertaken.

There was never a time in the history of the world when an active production was so much the object of solicitude on the part of so many people. That effectually modest achievement which was praised by Swift, of making two blades of grass grow where one grew before, has been set aside by the demands for the production of more corn, more milk, more wool and more meat. The menace to the life of the country called forth an unprecedented effort in its defence, but there has been some confusion and ineptitude, certainly more than there would have been if the building up of the national life had been a matter of scientific study and habitual work in times of

peace. Production as an activity has been marvellously exalted, while serious, helpful labour has not been the object of such respect and applause, or its opposite the object of such reproach and censure, for many generations. But was not production always the admirable and noble thing that it is to-day? Is it not the activity that does everything for us, giving us the foundations of life in the shape of food, clothes, furniture, and houses, and the finer things like jewellery, pictures, books, and leisure to devote to intellectual and spiritual pursuits? There is no one who does not depend on production for whatever he regards as desirable and necessary for his enjoyment. It is the activity which supports the man himself, and participation in which develops his life as nothing else does.

Production gives us clothes, houses and jewellery, and these things we call property. Production, therefore, is the parent or origin of property in one sense of the word. But it is related in a different way to what is called property in land, the sense in which the word is used in this lecture, since land is the basis on which all production takes place. Watches are property, but we cannot grow corn or graze cattle on them, or run railways over them, or use them as the basis of production. Property in land, therefore, carries with it the power to control production, to increase or diminish it. If things did seem obscure and complicated in times of peace, if there was doubt as to what were the really important things at which to aim in order to make the country great and strong, the pressure of war has cleared and simplified matters. The ideal is to utilise every little flicker of intelligence and skill and every pulsation of energy possessed by men and women in cultivating the land hitherto unworked or badly worked. To bring land and labour together has been the object of every sensible person who was in a position to accomplish it. That now has been acknowledged to be the most essential service which can be rendered to the country by anyone engaged in agriculture. What is true in war is true in peace. Men and women serve their country at all times, well or ill. In putting them to work on the land the best is done for both, no matter how feeble the intelligence and energy of the people, or how intractable the character of the land. The exercise of the qualities possessed by both makes for the satisfaction of everyone, because it makes both the people and the land better, and leaves a greater harvest to enrich the world.

The two foundations then on which production rests are the activities of men and the land on which those activities operate. If the actual source of the activities is sought, it will be found in the farmers—in their minds. On every farm there is a manager of some

kind who has framed a scheme more or less well adapted to produce the utmost out of the land. Every farmer knows what it means to make plans for the working of a farm. He makes a rough or careful calculation, according to his character; he is full of ambitions and hopes at one moment, and as full of fears at another, as to the success or failure of his scheme. However well conceived this may be, it is seldom that it goes through too easily. The soil is difficult at times, and when it and the weather get to work together in unforeseen ways, they make a rough sea for what is generally a frail craft. Such schemes can never be too robust or too firmly constructed, any more than our best ships can be too sea-worthy. It is true that in many respects things are better than they once were, that progress has enabled farmers to develop their business with more certainty, but, in spite of such improvements, there are market or other risks which make things still difficult, just as high speed does in navigation.

One essential fact, therefore, is that production depends on the well-laid plans of men, which Burns says "gang aft agley." The climate is beyond their control; the soils can be subdued, but they must be held in subjection by management which never relaxes its grip, and be supported by a full equipment of capital and labour. There is the situation. Hundreds of thousands of farmers apply their intelligence to the production of food and clothes, operating on the passive but indispensable basis of the land.

But the manner in which the schemes of farmers are accommodated on the land is not decided by its physical qualities alone, but by the intervention of the landlords as a class. Under the landlord-tenant system, these two classes of men are brought face to face and another set of relationships introduced. Questions of tenure and finance arise between them, and they must arrange to work together in some way. If the schemes for production are born in the minds of farmers, they are cradled and nursed in the estate management which prevails on the land where they are put into operation, and estate management as used here is simply another expression for property in land.

At the risk of being tedious, it may be useful to dwell for a moment on this aspect of agricultural organisation. A very large number of farmers are directly responsible for the management of land through their management of labour, live stock, and crops, and at the same time a comparatively small number of landlords are indirectly but finally responsible for the management of the land through their management of the farmers. This is the important position in agriculture, since its occupants possess power and influence

which have the most far-reaching effect for good on production, if they are properly exercised. Estate management is the management of men in a situation where they are by no means easy to manage. Landlords and factors must often have said to themselves that they have found "mankind an unco squad." Let us imagine their difficulties when ten or twenty men present themselves as would-be tenants of a farm, and it happens that out of the whole number not one is pre-possessing, that there is not one who has sufficient capital, or who is convincing as a manager. Some may not be well educated: they may be rude, or suspicious, or over-confident of their own capacities, and altogether unsuited for working agreeably with others. Where farmers are incapable managers or where they have insufficient capital, production is weak, and it is hard for estate management to strengthen it. To under-estimate the difficulties of the work is a mistake. Anyone may appreciate this who honestly recognises the effort which it means on his own part to maintain that degree of equanimity, disinterestedness and positive goodwill which are necessary for preserving a happy relationship between himself and those with whom he is closely associated, and, if inferences may be drawn from all the controversy and all the legislation which have taken place with regard to them, there are few relations which are harder to maintain in an agreeable manner than those of landlord and tenant. All this, and probably more, must be admitted, but that having been done, there seems to be no sufficient reason for estate managers standing aloof from work which inevitably belongs to them. To suggest that landlords and factors should act as tutors to farmers, and should put them through a course of discipline and training, may seem unreasonable, but this duty in some form is inherent in their position. Farmers get control of landlords' capital, and, where such a situation exists, the active interest of the party who has advanced capital is necessary to secure efficiency and satisfaction. The relations of agricultural landlords and tenants have never been placed on a strictly economic footing. In almost every case there is too little intimacy between the parties. Leases, for instance, keep them apart. They are a slovenly arrangement by which trouble is avoided, and under which questions of repair and re-construction, of good and bad farming, only come up at long intervals, hence the stimulus that ought to come from a landlord's interest is lost. If it is a question of security, a feeling of this with regard to tenure and improvements can be inspired in tenants not so much or so well by leases as by an intercourse which breeds in them a positive confidence, a consciousness that they are actually working with landlords whose association

with them has as one of its foundations an understanding of their difficulties, and a readiness to assist them in overcoming these. Leases, if they are adhered to, are apt to give one party an undue proportion of adversity to bear, or an undue share in the fruits of prosperity, and neither result is consistent with the substantial partnership which exists between landlord and tenant. To regard property in land as a department in the division of labour may call forth objections, but, in the organisation of agriculture, it is essentially this, and its merits as a system must be tested by the manner in which it serves production. It is the business of landlords to accommodate the occupiers and cultivators of land with facilities which will enable them to produce the greatest amount, and to see that these facilities are properly used. Two kinds of statements are made about the relationships of landlords and tenants. At one time it is said that their interests are opposed to each other, while at another they are said to be identical. Each statement seems to be true by turns. Whether the two interests are antagonistic or in agreement depends on what the two parties make them. If they pull together like a good-going team, both getting out of their joint labour what satisfies them, their interests are identical and consistent with each other, but if they pull against each other their interests are at variance. This problem is always coming up in the division of labour, between employer and employee, between seller and buyer, between landlord and tenant. If a man gets wages which are clearly and indisputably less than the value of his labour, his employer's interest is benefited at his expense; if a man makes what Burns calls "a daft bargain," the other party benefits at his expense, and, similarly, in the case where a farmer pays an unduly high rent, or where a landlord receives one unduly low. Yet in each of these cases it is possible, and it is a sound economic arrangement, to have both parties benefited and satisfied with their co-operation. The landlord's interest can be the tenant's, if they make it so, and this is the result towards which the main drift of economic forces is always driving them. Under the division of labour they must work together. There is no escape from this, and working together does not consist in cat-and-dog relationships, nor in law court relationships, but in reaching and preserving an understanding, however hard and laborious the work involved in doing this may be.

What is the part to be played by landlords in attaining this end? They are in possession of the land on which all producers must develop their schemes of production. These schemes change periodically owing to changes in markets, or to other causes which make for progress. Landlords also have schemes which they wish

to develop on the land as a basis. Thus differences arise for two reasons, first because landlords may be reluctant to provide proper accommodation for the new schemes, and then because they may have the desire to encroach on the occupation of others with their own schemes. With regard to the first kind of difficulty, it is a mistake to regard it as a slight thing. For men with estates that have been used in a certain way for years or generations it is not an easy thing to accept a change in use. It is disturbing to have to adapt one's arrangements to suit any new enterprise, however good. It must resemble the experience of being wakened in the first deep sleep of the night and invited to give up your comfortable bed to some person who will seem to be an intruder and a nuisance, no matter how fine a fellow he is or how desperate his plight may be. Landowners do get attached to a certain arrangement of things, and it is natural that they should. What is called amenity, pleasant and agreeable conditions, are built up during a long or short period, and a principal feature of amenity is absence of population and of enterprise. To leave agriculture for a moment, the difficulty of the situation may be illustrated by reference to railway development. Railway enterprise gave landlords an exceedingly uncomfortable time, and landlords gave railway enterprise some equally unpleasant experiences. This enterprise had to go on, but many landlords have never become reconciled to it, and many districts of the country remain in a backward state owing to opposition which seems to have been narrow in its outlook. The attitude is hard to analyse or explain, but it does seem to be inconsistent with the development of an enterprise which is essential to the life of the country, and with any other interest which one can conceive of as worthy. An illustration affecting agriculture may be taken from Scotland. In 1874 three crofters were tried before the Sheriff-Substitute of a certain district on a charge of mobbing and rioting. The principal witness for the prosecution was the factor on the estate. In his evidence he said : " I obtained decree on the summonses of removing, and, if I wished it, I could have removed all the tenants from their crofts and houses in B., as well as from their summer grazings in L., because the decrees gave me power to do so. I did not consult Sir J. about removing the people. . . . I am not in the habit of consulting Sir J. about every little detail connected with the management of the estate." " You considered the removing of 56 crofters and their families too small a matter to consult Sir J. about ? " " I did." This is an exceptional and extreme case, illustrating one attitude of property to production. It recalls some lively controversies ; but the subject cannot be evaded since questions

of population and production are inseparably connected. There has been in the highlands of Scotland for more than 100 years a stubborn contest between landlords and small farmers. In the first part of this period it was the resistance of the latter to the encroachment of the former, and within the last few years it has been the resistance of the former to the aggression and enterprise of the latter supported by the Government. A stop was put to the encroachment of the landlords by the Crofters' Act in 1886, under which the small holders obtained security of tenure, and in 1911 the Small Landholders' Act provided for the enlargement of existing holdings up to 50 acres in extent, or to £50 rental, and for the creation of new holdings of a similar size. Probably most people interested in and informed on the subject are prejudiced in favour of or against the policy of these two Acts. It was perhaps the only policy which could have been adopted at the time, but there can be no harm in discussing other alternative methods of securing an increase of production in the future.

Landlords generally have not become reconciled to the intervention of the Land Court between them and their tenants, nor have they given a friendly reception to the Agricultural Holdings Acts. All these Acts have been framed to give tenants more security and liberty, while restricting the power of the landlords. They are in fact nothing more nor less than a standing criticism and amendment of estate management. They are based on the assumption that certain conditions favourable to the farmer are essential for the prosperity of agriculture, and the mere fact of their existence is equivalent to the assertion that estate managers had failed to provide those conditions. Assuming that, when they were passed, nothing else could have served the purpose which they have served, is there not reason to think that something different could be devised for the future, something more agreeable to all parties concerned ?

The question will have to be decided before many years, for the new determination to secure increased production will certainly bear some fruit. A fuller education will lead to the birth of new ideas and new schemes for production, and estate management will require to be much more accommodating to these than it has been in the past. Will the landowners adopt this accommodating attitude ? Will they identify themselves sufficiently with the life of the nation which is renewed from day to day in the minds of the men who frame better and better schemes for producing more wealth ? Will they profess, and shape their policy in harmony with the profession, that it is not their own first and immediate personal wishes which will finally decide what use is to be made of

the land, and under what conditions it is to be used, but that it will be the needs of this expanding life of the nation? No class in the country occupies such an important and dominating position as the landlords, but, in order to fulfil the duties inseparably attached to that position, they must identify themselves with the advancing life of the country, which is greater than any class, submit themselves to it, and then come up as its leaders and servants. It is a magnificent position, but one that is difficult to fill. It is so easy for the landlord's office to become what is called an *imperium in imperio*, a dominion inside the supreme dominion of the State, with separate and conflicting interests.

While this work of estate management has the most far-reaching influence on the organisation of agriculture, no work has been so inadequately performed. Landlords and agents have never mixed well, or worked closely and smoothly, with farmers. This weakness is illustrated to-day. In the effort to secure increased production there has been no serious attempt to use the machinery of estate management, which, by its very nature, should have an effective grip on every farm in the country. The relations of estate managers to tenants are too loose or too uncertain in most cases to admit of any stimulus being applied through them. A letter appeared in *The Times* signed by eleven of the largest landowners in the country, saying that they would not raise the rent of any sitting tenant on their estates during the continuance of the war. Such a declaration may appeal to farmers, but there is nothing in it that suggests sound estate management—rather the opposite. But my purpose in referring to the letter was to quote a sentence from it. "The business of farming," the writers said, "is in the nature of a partnership to which the landlord contributes the greater part of the capital, the tenant providing the remainder, and being personally responsible for the working of the undertaking." But the partnership, in actual practice, is one of the least satisfactory that could be conceived from the economic, or money-making, point of view. If the landlords were to regard themselves as directors and the farmers as managing directors, in the business of farming, their relations would be enormously improved. If they came into the business as fully as their stake in it demands and justifies, they would discover that their partners or managing directors are hampered by arrangements which no directors in any other business would allow to exist. No man is too good for this work of estate management. Anyone who performs it well is qualified for the highest office in diplomacy or statesmanship. To handle two or three hundred farmers engaged in production well demands

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qualities of the very highest kind. For serious and practical purposes the landlords have stood aloof from this work. They have given themselves to a number of other pursuits irrelevant to this business, from which they draw so much of their income. Their agents are seldom expected to make good the deficiency, even if they might be capable of doing it. They are placed in a position which makes them largely Ishmaelites, and many of them are quite unfitted to perform what are perhaps the most delicate duties which belong to any class of men, to win and hold the respect of farmers, among whom are some of the most capable and shrewd men in the country. If landlords for any reason do not administer their estates, they ought to employ highly-qualified and highly-paid men as their substitutes, men who need not know mensuration or the principles of building and draining, but who can win the goodwill of farmers. Landlords have earned the reputation of being fine fellows in many pursuits irrelevant to their own proper business. They are fine fellows as sportsmen, as patrons of good breeding in live stock, as farmers, and as members of agricultural societies, but in estate management, the greatest and most unique work of all, they have failed, because they have always treated it as a secondary vocation, unworthy of their whole-hearted devotion to its duties. Education is at fault. In our universities and colleges we have courses in agriculture, in agricultural chemistry and botany, in surveying and other subjects, but I doubt if we have such a thing as a lecture on estate management, as if this, the most difficult art of all to acquire, could be learned without effort or training. The scope of this paper will not admit discussion of details, but it may be said that good estate management does not imply only the provision of soft and pleasant conditions for tenants, but frequently involves interferences even in what may seem private affairs, which will by no means be acceptable at first. Tenants can make havoc with the machinery of production in ways which have not been made the subject of jurisdiction by landlords or other authorities, but which ought to be.

Let us turn now to another aspect of the subject. The relations of production and property have been rather unhappy in Scotland where the small holdings movement has sought to make headway. It is unnecessary to express any opinion on the question whether small holdings offer the best method of increasing production by putting capable men to work on cultivable land. There are other methods which might yield similar results in respect of the effect on men, land, and production. But the fact remains that a very reputable and possibly overwhelming body of opinion in Scotland

favours an increase in the number of small holdings on the ground that they are economically sound, and absolutely indispensable for the maintenance and expansion of the national life, and that the process of curtailing the area of agricultural production, and of depopulating the country, which has been in operation so long, should be reversed by this method. Most impartial people would admit that a scheme thus supported ought to have the opportunity of being tested by experiment. But the attitude of property to this style of increasing production has been unfavourable enough to place the movement in difficulties. The creation of small holdings was initiated in the Small Landholders Act of 1911, but the Lindean case has made it evident that the refusal to grant the movement the economic conditions necessary for its success is to be made effective. There are two principles of valuation embodied in the Act, the first having been taken from the Crofters Act of 1886. This guides the Land Court in fixing rents and in awarding compensation to owners when land is taken and the claim for compensation does not exceed £300. The other was taken from the Lands Clauses Act of 1845, and guides the procedure of the arbiter in awarding compensation to owners when the sum claimed is over £300. This principle was inserted in the bill by the House of Lords at the last moment. The difference between the two principles is that, in the first case, regard is had to what the tenants are able to pay in the form of rent and compensation, while, in the second, no regard is had to this whatever but only to what the owner loses by injury to the amenity and value of his estate. The second principle is the one under which land has been taken for railways and other public undertakings, such as waterworks, but it is clear that the standard of payment which applies in the case of railway companies and public bodies, with their power of fixing fares and rates, cannot be applied to small holders who have to earn every penny in the face of soil and climatic difficulties which try the best equipped farmers. Discussing this question a few months ago, in connection with the Small Holdings Colonies Bill, *The Scottish Farmer* said the scheme was "foredoomed to failure in Scotland, if compensation for land taken is to be based on the principles adopted and confirmed in the Lindean, South Uist, Garmony, Ballencrief, and Ardfenaig cases." There is little doubt that this opinion is true. The rent fixed by the Land Court, together with other sums paid, gave the landlord in the Lindean case a return from the farm greater by £23 a year than he received from the previous tenant. But this was increased by £154 a year, representing interest of 4 per cent. on £3,850 awarded to the owner by the arbiter, a charge which involves the diminution

of the capital which can be devoted to agriculture in Scotland. The feature of this case and of the others which is repugnant is that they are incidents in a somewhat bitter internecine war, a war which has weakened this country in the face of its relentless enemies from outside. This makes it exceedingly difficult and unpleasant to discuss the situation.

The impossibility of creating small holdings under the principle of compensation in the Lands Clauses Act must be recognised by every intelligent and well-informed person. This fact must have been known by those who thrust that principle into the Small Landholders Act. In the Lindean case, from the moment the arbiter entered upon his work until judgment was pronounced in the House of Lords, not one instant's thought was given to the economic needs of the small holders, nor to the question what would become of their productive enterprise, if such-and-such a decision were made binding. The Lands Clauses Act does not permit that. The decision is as sound in law as the law is unsound in economics. The arbiter and judges must turn their backs resolutely and strictly on the needs of the enterprise. It is probably only economists who suffer thus in their experiments, and chemists and botanists suffer indirectly through this economic disability more than they do from any direct handicap attached to the development of their own sciences. The arbiter in the Lindean case decided that the small holdings would depreciate the value of the estate. No outsider would dispute that decision on particular grounds. But on general grounds any economist would question it. In hundreds of cases railway companies have been compelled to pay compensation for depreciating the value of estates, when the actual result of their enterprise has been to increase their value a hundredfold. Increases of production and of population are almost universal causes of increased value of land. More than 2,000 years ago Cato, in giving advice to landlords about choosing the situation of an estate, said:—"Let a thriving town be near it, or the sea, or a river on which ships ply, or a fine and popular road." Population and accessibility to roads and waterways made estates valuable at that time. They have always done so, and prejudice against them and a policy detrimental to their development are unjustified from any point of view. The Lands Clauses Act makes it a misdemeanour to bring a good road through an estate. The regulation and direction of this development in the manner most consistent with the wishes and interests of everyone is work of the highest value for the country, just as the practice of crushing absolutely, or of crippling, these frail infant enterprises by disabling exactions, is pernicious.

Estate management, including the work of land stewards and sub-agents as well as of legislators and law lords, is out of harmony with every sound movement to-day. Agricultural and other technical education has been wonderfully developed, and there is a demand for more of it. But why should there be such one-sided progress, why should there be any increase in the number of educated and efficient men who are to be confronted with this blank, impossible situation, men equipped to exercise their faculties on opportunities which are withheld from them? The education of landlords, agents, and legislators in the art of making the material basis of production available to the active and educated producers is by far the most important part of education to-day. Every other branch of education has outrun this, and its backwardness acts as a fatal drag on the progress which everyone desires. For estate management landlords require to cultivate a sense of humour, and imagination, to be able to put themselves in the place of the tenants, and occasionally, when cases come up in which they are both parties and judges, to decide such cases even against themselves, would ensure a handsome return of every kind. Until imagination has been cultivated, or the capacity to do to the other fellow as you would have him do to you, the Land Court seems to be a necessary arrangement. It and its predecessor, the Crofters Commission, have improved estate management enormously in the Highlands. According to the testimony of landlords, agents, and arbiters, it has increased the value of Highland estates, made crofters appear better men to the landlords, and landlords better men to the crofters. Its cost has been a good investment. It has increased production, and kept more men on the land than would have been there without it. There is much work for it and the landlords still to do. There are capable men and land might be measured out in exactly fitting portions to engage their capacities fully. This would make the land yield its utmost, make the men themselves great and strong, and still further increase production and enlarge the life of the country.—*From The Scottish Farmer.*

Line Breeding.—Although inbreeding is very closely connected with prepotency, it is very evident that it is not the only factor the presence of which is necessary, since although practically all prepotent animals are either closely inbred or have concentrated blood in their pedigrees, a great many closely inbred animals are anything but prepotent. When we begin to inbreed a new stock which has not been inbred before, we find that the individual animals we produce differ very widely from each other in their power to impress

their offspring with a uniform type. Now, however closely we may inbreed, we are bound to introduce some alien blood, though it may only be a small quantity, in every generation. Those individuals whose offspring show the greatest uniformity are those in which the determinants representing the desired type are strongest; and since these, from the commercial and practical point of view, are the most valuable, we continue to breed from them, rejecting the others. We are thus intensifying the strength of these particular determinants, until the time comes when they become predominant, when our type will be fixed; but even then the longer we continue breeding the more stable it will become.

We can therefore understand how it was that Cruickshank succeeded in maintaining his type, although many of his cattle had only 25 per cent. of the blood of Champion of England in their veins, and how a good animal bred upon these lines is able to spread his influence all over the whole country-side, and why, in the case of an exceptionally fine specimen, he may fetch his weight in gold by public auction.

Many of us here probed the problem of breeding in the light of Professor Weismann's "Theory of the Germinal Selection," for the reason that that theory is widely known and has received general acceptance; but no microscope has ever yet revealed to human eye the struggle for existence which Weismann assumes to be continually taking place in the germ cells of every living being. On the other hand, Bonhote, in his "Vigour and Heredity" (1916), had a good deal more ground to go upon, which had been cleared by direct experiments, when he formulated his vigour hypothesis.

To put it shortly, a high state of vigour is the cumulative result of generous feeding and a favourable environment, maintained during several generations, the benefit which each generation derives from them being passed on, on the cumulative principle, to the next. A high state of vigour in the individual results in increased size, activity, milk production, thickness of flesh, quickness of growth, and the rest of those desirable qualities which we value in our stock. On the other hand, a low-vigoured animal tends to be a scrub. In addition to this, as Bonhote proved in a large number of direct experiments, a high state of vigour is inherited as a Mendelian dominant, together with the characteristics which are associated with a high state of vigour, or, as in some cases, with some purely personal characteristic which is possessed by the high-vigoured individual. For instance, Favorite 252 was mated with a common cow, and the offspring was the famous Durham Ox, which inherited in a large measure the high vigour and improved type of his sire in

preference to the inferior type of his dam. Again, Eclipse, the famous thoroughbred horse, transmitted to his descendants not only his high vigour and his speed, but also a peculiar white mark which appeared true to type in all his descendants for many generations.

If a high-vigoured animal is loosely bred, his offspring will inherit some at least of his heterogeneous blood lines, and it will therefore be impossible for them to be uniform as regards type ; but, if he possesses a fixed type himself, this will be inherited by his offspring and remoter descendants, according to the Mendelian law, in conjunction with the high state of vigour, and he consequently proves himself to be prepotent. Looking at the matter from this point of view, we see that two factors are necessary to produce prepotency : first, a high state of vigour to influence the inheritance, and secondly, a fixed type to secure uniformity amongst the offspring,—corroborating the results which we obtain from a study of pedigrees.

The ability to impress offspring and remoter descendants with a given type is called the Power of Transmission. Without it the finest blood, pedigree, ancestry, and individuality, are worthless. We should not be wrong if we were to re-christen it the Power to Deliver the Goods !!! Just as the proof of the pudding is in the eating, so the proof of the breeding of a herd, flock, or stud is in the power of transmission which the individuals in it possess.

The power of transmission varies greatly in intensity. In some cases it is so feeble as to be hardly noticeable ; in other cases it is very strong, and persists during many generations. In most cases it runs most strongly in one direct channel, which may be either through the male or female sex.

Last autumn a shire foal, a few months old, was sold at Peterborough, in England, for a remarkable figure. His sire, Champion's Goalkeeper, was twice champion at the London Shire Horse Show. Now, he was a son of Childwick Champion, three times champion sire of London winners, his stock winning thirty-one prizes at these three shows. The next ancestor in the direct line is Carbon, a great winner ; then comes Harold, twice first at the London show himself, and for many years the champion sire of the Shire Breed in England. He in turn was a son of Lincolnshire Lad 2nd, another great sire, from whom many other great blood lines are descended. One can find an equally remarkable list of sires and winners in the male line in the pedigree of Earl of Kingston, the Edgcote Shorthorn Company's great bull. Yet, on the other hand, one can discover just as large a number of instances in which transmission has been through the female line. One very famous instance is that of the Darlington's in the late Mr. George Taylor's herd of Dairy Shorthorns

at Cranford, which have produced more great cows-milkers, breeders, and show cows—than any other dozen families of Short-horns in the Herd Book.

Although transmission will flow readily enough through a direct line, a considerable increase in its intensity will be required to enable it to divert its course from one line of transmission into another, whether it be through the opposite sex or through a new line of blood altogether. So that, although there may be well-defined transmission through one particular line of females, it does not therefore follow that we shall be able to maintain its continuity if, for example, we take a bull of this particular family and mate him with cows of other blood.

Transmission is very closely connected with what we may call the "vitality" of a family or of a particular strain. We often find a family that will rise up all at once, produce a brilliant constellation of winners for one, two, or three generations, and then fizzle out like a damp squib; whereas other families will produce great winners and great breeders for long periods of time. The chief feature in the history of English show-yards, during the period extending over the whole of the middle half of the nineteenth century, was the unchallenged supremacy of the Booth cattle, and this applied not only to those animals which were in the hands of the Booths themselves, but also to those in the hands of others. The Booth cattle carried off all the prizes at all the shows with clockwork regularity. An old cow and her descendants for several generations, both male and female, would win the prizes on the same occasion. In all probability, England's best cow to-day is Bright Jewel, one of Torr's Brights, whilst her daughter Bright Pearl was Champion at the recent Royal Show at Manchester.

More than a century ago Thomas Bates purchased over a hundred of the best and the best-bred cows money could buy in the whole of England. From these he selected the six best, from which the Kirklevington tribes are descended. Animals of Bates blood are winning prizes in the show-yards and establishing reputations for themselves as great sires to-day; and we must remember that the blood which is demonstrating its worth to-day is the same blood—diluted and re-invigorated by the infusion of a certain amount of new blood it is true but still in the main the same blood—that was producing the best animals in Bates's day and a hundred years before that. We must of course recognize that the skill of the breeder is a factor in the situation; but even after making every allowance for this, we must also recognize that the vitality of the breed is a thing we cannot afford to disregard.

In the middle part of the eighteenth century England possessed two remarkable thoroughbred stallions—Eclipse and Herod. During their lifetime, and for some time after, there was nothing to choose between the two animals or their progeny. Very soon, however, the line of Herod dropped out altogether, and only produced third or fourth rate animals, whilst the blood of Eclipse has held an unchallenged supremacy right down to the present day. The Herod blood, however, has within the last three or four years produced one first-class horse in The Tetrarch. How can one account for this?

Variation is the most constant factor in nature. It operates like a thermometer whose motion is irregular. Sometimes the rise will be great and at other times it will be small, and on rare occasions, at long intervals of time, its movements will be quite abnormal. Let us imagine for a moment that the mean vigour of the Herod blood is 50 degrees, and let us suppose that 100 degrees of vigour are necessary to produce a great horse. It follows that it will only be on those rare occasions, occurring at long intervals when the vigour rises to its extreme limit in the upward direction, that it will touch the 100-degree mark which results in the appearance of a great horse. On the other hand, if we place the mean vigour of the Eclipse blood at 75 degrees, it will only require a very moderate rise to enable it to reach this point, and, therefore, this line of blood will produce great horses with greater frequency.

Let us now take a comprehensive view of the whole subject of prepotency, transmission, and vitality. In the first place, we have the results of Bonhote's experiments, which prove conclusively that variations in the vigour of the individual, or changes in his environment which react upon his vigour, have a decisive influence upon the operation of Mendel's Law, in many cases so camouflaging it that the application of Mendel's system to such cases has been denied, and scientists tell us that in some cases Mendel's Law holds good, whereas in others it does not.

In the next place prepotency is invariably associated with what breeders term "character," whose outward manifestation is that robustness and vigour of expression that can only be present where perfect health and spirits are co-existent. Regarding this, Professor F. R. Marshall, in "*Breeding of Farm Animals*," tells us that the robustness and vigour of expression read in the countenance, and mainly in the eyes, and also reflected in boldness of movement, are probably the most directly associated with prepotency of all the things that may be regarded as contributing to character. The

appearance and manifestation of maximum vigour and vitality can only be present where all organs of the body that have to do with digestion, circulation, respiration, and the nervous system that controls all, continuously perform their full work. The maximum efficiency of all organs makes up constitution, and is indicated nowhere else so satisfactorily as in the expression of the carriage and in the general bearing, behaviour, and carriage. The presence of this condition cannot change the make-up of the germ plasm, but it may control its strength and power, and thus give it a much higher degree of prepotency than would be possible if the animal had been naturally weak or listless and low in physical vigour.

Then we come to the phenomenon of transmission, which is sometimes so weak as hardly to be perceptible, whilst in other cases it is so strong that the blood possessing it is placed in a position of unchallenged supremacy. There are, again, natural barriers separating channel from channel, which serve to confine the weak, but which prove no obstacle to the vigorous and strong. Finally, we find the members of a high-vigoured family living to a ripe old age, whilst a low-vigoured stock, although they do not exhibit any very marked differences in the days of their youth, die off young. What is true of the individual is true of the race. A high-vigoured race will maintain its high vigour through long periods of time, whilst a low-vigoured one, though it may exhibit all the appearances of high vigour for some short time, will sooner or later fizzle out as did the blood of Herod.

If these premises are correct it follows that there are only two factors which a breeder need take into account: a high state of vigour, and fixity of type. A high state of vigour will produce those desirable qualities which he values in his stock, and which fixity of type will secure to him. Vigour and fixity of type combined will secure him prepotency, and a high state of vigour will secure to him powers of transmission and vitality.

Although convinced of the beneficial effects of inbreeding, one must admit that there is a great deal of prejudice against it. In the first place, it is contended that inbreeding will perpetuate bad points as well as good ones, and will also accentuate any undesirable tendency which may be present in the blood. This is admitted, but the answer we make is that we do not give strong drink to babes, nor do we place a high-powered motor-car in charge of a lunatic. If we are going to take the trouble to breed upon scientific lines, it is worth our while to go to some little extra trouble to get the very best material as the foundation for our structure.

The second objection, which is based upon surer grounds, is that

inbreeding is injurious to the constitution, and that it results in decreased size, vigour, and fertility. Professor Cossar Ewart once declared that the stuff of which animals and plants are made—the living clay or protoplasm—has a limited lease of life, and is only capable of giving rise to a limited number of generations unless revived and rejuvenated by the introduction of fresh blood. As to the reason why this is so, there seem to be reasonable grounds for saying that vigour is maintained as long as the uniting determinants differ from each other *chemically*, even though they may bear the same unit-characters, but that loss of vigour ensues whenever they are chemically homogeneous.

Professor James Wilson, in his “Principles of Stock-breeding,” is convinced that there is scarcely a British breed of live stock but was established by inbreeding, and has been maintained in some degree on the same theory right down to the present time. But although, as a rule, the greatest stockbreeders have practised inbreeding, the rank and file have been inclined to look upon it with suspicion.

Does Professor Wilson provide a clue which will reconcile these two contradicting sets of opinion? As practical breeders, we know that one of the chief points of difference between a successful breeder and one of the other sort, is that whereas the former keeps his stock in good condition, the latter does not do them so well. Hence, if we are going to put forward the view that inbreeding reduces vigour, we are bound to accept the other portion of the vigour hypothesis, and admit that generous feeding and a favourable environment will increase the vigour and so counteract the loss due to inbreeding. Each class of breeder then speaks as he finds. The successful man obtains the beneficial results of inbreeding without experiencing its drawbacks; the other the bad effects of the loss of vigour which far outweigh any advantages he derives from the type being stable. The system of inbreeding would appear to be both profitable and unattended with risks, if one takes the precaution of keeping his stock in sufficiently good condition to counterbalance the resultant loss of vigour.—HORACE G. REGNART, M.A., in *Live Stock Journal Almanac*.

The Yields of Cereals.—Reports as to the probable yields of grain from the different cereal crops in various parts of the world, and the influence of these reports upon prices, remind us very forcibly of the importance of yield to the agriculturist, and also draw attention to one of the great differences between agriculture and nearly every other industry. Given a certain quantity of raw material and the

necessary labour, most producers can estimate almost exactly the amount of the finished articles they can turn out, and so are in a position to forecast not only the quantity they will have to sell, but also the exact cost of production. With the farmer this is an impossibility. He may have good land, cultivate it in the most approved manner, manure it with the best of judgment, sow the best possible seed, keep the crop thoroughly clean, and yet, in spite of all his care, the crop may be a poor one. No estimate based merely on the raw material and the labour, however skilful the labour may be, is of the slightest value; for the amount of produce he obtains the farmer is largely dependent on factors over which he has no control.

Complaints are sometimes frequent and come from many quarters as to the disappointing yields of cereals. Crops that looked like giving large yields have, under the test of the threshing machine, fallen many bushels and in a few cases even quarters short of the estimates. Of such failures no one seems quite to know the reason, but they are most disappointing to the farmer. He has taken every precaution to secure a good crop, and by all external appearances would appear to have secured it, but the yield is not there—something has intervened to prevent the proper growth of the grain. The actual monetary return to the farmer falls short by pounds of what he had every reason to expect. Why these shortages occur is a problem well worth investigation and one to which the agricultural scientist might profitably give some attention. It would certainly be most interesting to know exactly why it is that a field of wheat that appeared to be good enough to yield five quarters an acre should, when threshed, yield only four quarters. The discovery of the real reasons might quite possibly suggest a remedy, if not for the whole of the evil, at any rate for part of it.

In the present state of our knowledge one can only vaguely attribute the cause of a disappointing yield to the season or to the land or to the variety. We are quite unable to state even how far any one of these vague factors was responsible for the result, and we certainly know very little as to how far any one of these factors may influence the others. There are, however, considerable possibilities of increased knowledge suggesting a partial remedy. It is well known, for example, that certain soils have a tendency to produce crops of cereals in which the yield of grain almost invariably falls short of the promise, as judged by the appearance of the crop at harvest. Other soils just as frequently produce crops that yield as well or even rather better than appearances would warrant. There must be some definite cause for this difference,

and although the season or the variety may influence the yields to some extent, the actual cause of such a constant difference must be sought in the soil itself.

The results of experiments on the manuring of cereal crops on different soils seem to indicate that the presence of a sufficient amount of available mineral plant food in the soil has a good deal to do with the yield of grain. Soils apt to yield badly in proportion to the straw are often made to yield much better by the application of mineral manures. Phosphates seem particularly productive in this way on clay soils, while on others potash seems necessary, and on many others lime is required as well as phosphates. Soils giving good yields, on the other hand, are more responsive to nitrogenous dressings, which would seem to show that they already contain a fair share of mineral plant food in an available condition. The whole subject is well worth thorough investigation. A definite knowledge of the influence of these mineral plant foods on the yields of grain might be of great use, in permanently increasing the yielding powers of certain farms and soils. It is also quite possible that some part of the effect of the season in influencing yields might be found to be due to the influences of the weather on the availability of the different plant foods in the soil.

The particular variety of the different cereals sown undoubtedly makes a considerable difference to the yield. Farmers have found from experience that some particular variety of oat or wheat suits their farm, or part of their farm, better than another, and repeated comparative trials of cereals at our experiment stations have shown that the variety that generally does the best at one station need not necessarily do the best at another in the same season, while in different seasons the varieties may change places as to yield. It has, however, been conclusively shown that certain varieties may be depended upon to give always a large yield and to be amongst the first two or three in any trials, almost irrespective of soil and season. Other varieties commonly grown are just as consistently found to be amongst the last three or four as regards their yield, and it is certainly remarkable that such varieties should continue to be grown by farmers when there are so many far better kinds from which they could choose.

These facts are not without their special significance, and might be made far more use of than they are. Climatic conditions we shall probably never be able to change, but soils can be improved considerably by skilful cultivation and manuring, and many of the poor soils of the past can now be made to give far larger yields of grain than at one time was thought possible. The necessary manures

are already available, and improvements in cultivating machinery are already beginning to make possible the thorough and easy cultivation of soils hitherto difficult to work. The improved varieties of cereals are, moreover, available to everyone at the present moment, and there is now no excuse for sowing or further perpetuating the seed of inferior varieties. Several of the new and re-selected varieties of oats, barley, and wheat can be depended upon to give yields of several bushels an acre more than many of the older kinds, so that a little expense in acquiring a stock of seed is more than repaid in a single crop. All the new introductions have not proved to be successes, but information as to the best varieties and those most suitable for particular districts and soils can always be obtained from the nearest experiment station, and is available to every farmer who cares to write for it. It always pays well to sow good seed.—*Agricultural Gazette*.

Our Waste Lands.—No one who travels about this country can help being struck by the enormous amount of absolutely waste land that is to be found in every county and almost in every parish. The ordinary person has become so used to seeing it that he is inclined to regard it simply as a part of the country, but to the foreigner, or to the Englishman who thinks about it, it is a most extraordinary sight. Here is one of the most thickly populated countries on the globe, that is dependent on foreigners for the greater part of its food supplies, and yet within its own shores are millions of acres, that might be growing food, lying waste and uncultivated. Some of these lands are poor and barren it is true, but by far the larger proportion of them are not really barren at all, and suffer from no climatic conditions that would prevent cultivation. They are simply poorer from some cause than the lands of the surrounding district and were for that reason left uncultivated in the days of the first agricultural settlement of the country, and have remained uncultivated ever since.

Scientific investigations and experiments have shown that these waste lands are generally poor in an agricultural sense simply because they are deficient in some essential plant food, and that in most cases were this substance supplied artificially the land would be capable of profitable cultivation. In nine cases out of ten, indeed, in millions of acres the deficiency is in lime, an ingredient cheaply and easily supplied. Nearly all the sandy commons and wastes all over the country could be successfully cultivated if dressed with lime, and as limestone exists in large quantity in every county, there should be no great trouble or expense in obtaining the necessary

lime. It is possible to estimate the exact amount of lime necessary to bring about fertility in a soil deficient in this ingredient, so that there need be no waste or greater expenditure than is necessary. A considerable area of land is still unfertile for want of phosphates, generally heavy land, though a good deal of this is being dressed with phosphates and gradually improved. One of the most striking instances of the improvement of waste land is shown in the results obtained by dressing the chalk downs of Sussex with basic slag. The remarkable results obtained on some hundreds of acres have shown that these almost waste lands are capable of being turned into excellent pastures at a small expense.

In a few cases drainage will be necessary before certain wastes can be reclaimed, others will require a good deal of labour to clear them of gorse and other bushes, while here and there belts of suitable trees would require planting to protect the land from wind. This would probably be the case in a good many places in Cornwall, where there are probably about 80,000 acres of waste land. Such an area would appear to be immense for a single county, but both Hampshire and Yorkshire would possess far larger areas. To what area the total waste lands of Great Britain extend it would be difficult to say, without some statistics not at present available, but it would be well within the mark to say that the cultivated area of England, Scotland and Wales could be profitably extended by five million acres. To this could be added another five million acres of land, included in the returns as pasture, that is of the poorest possible description, often covered with gorse, fern and heather, and which has never received any manurial treatment or care of any kind within the memory of man.

The reclamation of these waste and semi-waste lands is a subject that should certainly come within the scope of the committee appointed to inquire into the development of the resources of the Empire, and would, without doubt, give far better returns for the money expended than any scheme of small-holdings, which entails taking land from farmers who are already cultivating it. Two million pounds spent in the reclamation of waste lands would give permanent employment to two or three thousand men, and bring into cultivation an area capable of providing bread for a couple of million people year after year. A few millions spent during the next five years on the reclamation of wastes would mean numerous additional farms, if required, for small-holdings, the employment of many more men permanently in agriculture, and a large increase in the food supplies of the nation.

It must, however, be stated that little or nothing can be done

without drastic legislation. The greater area of our waste lands have remained waste because, in the periods before agriculture became a systematic industry, certain people had acquired the right to graze stock over the wastes, and it has been impossible to introduce cultivation without dispossessing these people of their rights. It is also quite impossible for these people to cultivate or reclaim the land themselves, because they have no right to keep off other people's stock. This ancient and now absurd state of affairs is in itself entirely and solely responsible for the existence of many millions of acres of waste in this country. Ten persons possessing the right to graze five hundred sheep or a few ponies may prevent the cultivation of 10,000 acres. This frequently happens, and is a thing that should not be allowed in the twentieth century and in a closely populated country. Well-cultivated and fertile fields run right into the wastes, not because the cultivated land is better, but simply because it is owned and fenced so that the individual can reap what he sows.

No one would suggest that these people should be arbitrarily deprived of their rights without compensation, but it is ridiculous that millions of acres should be practically lost to the country because of the common rights acquired by a few hundreds of people. It is equally absurd that land should be kept out of cultivation for sporting purposes, and both problems should be taken in hand at the same time. We shall probably have thousands of men needing employment after the war, and in what better way could a few million pounds be spent than in reclaiming waste land which would provide permanent employment for a large amount of labour and increase the national income? It is a question that concerns farmers as well as the general public. More land would be available for cultivation, and there would be no necessity to displace farmers for the provision of small-holdings. Let farmers see to it that money is not wasted on absurd schemes for providing employment in unproductive enterprises when there are lands to be prepared for occupation by labour that neither the farmer nor landowner can afford to pay for under present circumstances. It is a national concern, but one in which farmers should be deeply interested.—*Agricultural Gazette.*

Shire Horse Breeding.—Probably no breed of animal has altered so much or had such changes of fortune as has the Shire. Breeders have had many ups and downs, but at the present time are reaping a rich reward for their faith in and support of their favourites. All breeds of stock are enjoying a spirited demand, and high prices are

the order of the day, but none are experiencing such a good all-round demand as is the Shire. The "Old English War Horse" of centuries ago has justified the title in the modern fields of strife, and now victory has crowned our efforts no little credit is due to the help given by the Shire, who has added fresh laurels to those already won in other fields both of peace and war.

In days of old brute force held sway, and the strongest was the conqueror; but to-day things have altered, and instead of crashing through the ranks of the foe with irresistible force, the Shire takes his place in moving heavy guns and the enormous supplies that modern armies need. In modern warfare, where armies remain stationary for many months perhaps, it is not the light cavalry horse that is needed so much as the type that can shift the greatest weight with a certain amount of activity, and here the Shire stands pre-eminent.

Old supporters of the breed have witnessed many changes, and it may not come amiss to consider some of these. Gone to their well-earned rest are all the old stalwarts of the breed, and of the original Council not one now is with us. What a debt present-day breeders owe to those grand old men of the old brigade who in 1879 founded the Shire Horse Society and commenced the task of collecting and publishing authentic pedigrees of the breed! Since that time there has been no looking back, and each year has added further strength to the Shire. From such a humble foundation what a mighty edifice has sprung! In the first Stud Book the names of some 389 members are given: to-day the figures are nearer 6,000, and hundreds are joining all the while. The majority of these are tenant farmers, who have been and always will be the great mainstay of the breed: but these owe much to the support of the nobility and wealthy admirers of the breed, who are willing to give high prices for the best that the farmer can produce, and many of whom place at the disposal of their tenants the best sires of the breed at a merely nominal fee.

At the first show held by the Society some 114 animals were shown; but in 1916, the last year the show was held in London, the number of entries had risen to 527, and this number was considerably exceeded in previous years, until lack of accommodation made it necessary to limit the entries to a certain strength. These figures give some idea of the growing support of the Shire, and perhaps some figures as to the increase of soundness in the breed may be of interest. At the first London Show we are told that "Many good animals were sent from the ring as the result of the veterinary inspection, whilst at the next year's show some 15 per cent. of the

entries were rejected by the vets." ; whereas at the 1916 show all but some 5 per cent. came out of the dread ordeal with flying colours and during the ten years (1907-16) out of some 2,662 horses examined only a mere 7 per cent. failed to pass. Also at the Peterborough sales in March, where all classes of Shires are to be found, some 80 per cent. of the stallions were sold sound. Is not this a record to be proud of and does it not give the lie direct to those supporters of other breeds who, jealous of the prestige of the Shire, endeavour to attack it by unfair means ? Let them produce their facts and figures, and see how the soundness of their favourites compares with that of the grand old Shire. Again, they hint that the Shire does not wear. Let them go on the Shire man's pilgrimage to Islington in normal times and see one of our annual treats, that class of veterans who fight their battle towards the close of day with all the dash and freshness of those of younger years. If the breed does not wear, why do town buyers pay up to 300gs. for geldings for town work ? Pick up the catalogue of any Shire sale, and one finds many a mare of twenty years or more with foal at foot. Take one example : the great show and breeding mare Halstead Lady Harold, who proved such a perfect treasure-store for the Bradleys, is or recently was alive and breeding at twenty years of age.

Probably no breed has altered in type more than the Shire, which, whilst still retaining the old characteristics that have made it so eminent in the horse-breeding world, has greatly altered in many ways ; and who will deny that the change is for the better ? Gone are the old coarse-legged animals of the past, and the Shire to-day is a smarter, more attractive animal, which, whilst still retaining all the weight and substance of its ancestors, has a cleaner leg with better joints and finer, more silky hair. This hair is quite as abundant as in days of yore, and adds to the attractiveness of the breed, instead of being somewhat of an eyesore, as were the coarse-legged types of days gone by. It is one of the chief characteristics of the breed, and breeders must see that they retain it, for surely as they lose the hair so also will they lose much of the weight that is one of the Shire's best qualities. Faddists may talk and rival breeders rave, but the hair of the Shire must be retained. Many will say : " The town buyer and the foreign customer will ask for a smarter, cleaner-legged type of animal, and Shire breeders must breed to satisfy their requirements." Make no mistake and heed them not ; sacrifice neither hair nor weight ; breed as much as you can for both ; no matter how heavy and well-feathered animals you breed from, there will be plenty come to satisfy any demand for animals of this so-called modern type.

A few decades ago a considerable export trade was done in Shires, which had a not unmixed effect on the fortunes of the breed. Undoubtedly many animals left this country for their country's good—animals which, if retained, would only have done harm to the breed at home; but unfortunately they did great harm to the reputation of the breed in foreign countries. If they had been sent to some of the continental ports they might have met the fate that their merits deserved. Unfortunately, however, they were purchased here at low prices, and sent across the Atlantic, where on reaching the other side they were offered to breeders there as typical specimens of the breed, with the inevitable result that these became disgusted and turned their attention elsewhere. Thus the Shire got a bad reputation which takes some rubbing out, and it is up to breeders to see that the breed is shown in its true colours to foreign buyers, so that the Shire takes its position, not as the old *English* cart-horse, but the cart-horse of the world.

There is an unlimited field open to breeders if only they have the enterprise to explore its possibilities, and any trouble now will be a mere nothing in comparison with the great reward that will come as a recompense for their endeavours. These years of strife have depleted the horse stocks of the world to such an extent as has never been known before, and the efforts of breeders to make good the deficiency will cause such a demand for breeding stock as the world has never seen. Foreign breeders who have been cultivating a lighter type of horse are beginning to see the need for more weight in their animals where weight has to be shifted, and naturally their attention will be turned to those quarters where this weight is to be found. It is up to breeders to leave no stone unturned in their endeavours to see that this attention is riveted on the Shire, and to see that when once the attention is attracted it is treated in such a way that foreign buyers give their support steadfastly to the Shire.

Now, Shire men, remember all the error of your past, forget the old methods of wait and see, and be up and doing before it is too late! You have the goods: exploit their merits to your very utmost; and having drawn the eyes of the horse-breeding world in your direction, show them that you can deliver the goods that they require, and they will pay your price. Seek out fresh fields and pastures new for the Shire where it may be seen, and then by its merits it shall conquer and reign supreme over all competitors. Breeders, sound loud and clear the clarion call of what the Shire has done and what it can do under all conditions. The prize is well worth winning; other eyes are watching, and they will spare no effort to secure it: but the Shire has one great advantage: it

has the merits to sustain all claims, and when other countries are induced to try the breed and find its merits they will come again and be greater customers than before.

Far too many people basking in the warm sunshine of the present great demand are inclined to say, " Let well alone, and let the future take care of itself ; " but no greater mistake could be made. Present prices are sensational, but greater triumphs are in store if breeders take care not to neglect their opportunities. A decade ago four-figure prices were spoken of with bated breath, but to-day they hardly receive more than passing notice. No price can be too high to pay for the best sires of the breed. One thousand guineas is quite a common figure now to pay for the hire of a noted stallion for one season's use, and much higher fees will yet be obtained, so that the whole thing is established on a sound commercial basis.

If breeders will take steps to secure the enormous foreign demand that will be theirs if they will do their best to attract it, this will be no mean factor in keeping up such prices.

A few decades ago the travelling of stallions was largely in the hands of private owners, who travelled what they would and cut prices to secure a season, with the result that hundreds of worthless brutes were travelled that left black stains on the reputation of the Shire wherever they went. Now, however, this is largely changed, and the chief elements in the stallion world are the societies who hire horses at substantial fees to travel in their district. These are able to give a higher price and secure a better class of stallion, and above all a sound one ; so this in turn enables the stallion owner to give higher prices for likely colts to develop for this trade. These are largely in the hands of farmer breeders, and the high prices paid for them have no little effect on the breed in general, for a farmer having sold a colt at a good price endeavours to secure a better type of mare than the one he has, whilst his neighbours, hearing of his success, wish to do likewise, so that in this way many new supporters are gained for the breed.

As to the future, what can be said ? Why this : If breeders do not neglect their opportunities, and leave no stone unturned in their efforts to push the breed, the future is so golden that in comparison all the glories of the past will seem as nought. Every breeder can be a cog, no matter how small, in the great wheel of progress of the Shire. Surely each member of the society has at least one friend who could be induced to take an interest in the Shire and join up to swell the ranks of supporters of the breed. But it is no use the little wheels turning if the main parts at headquarters are rusty and motionless.

Whilst paying full heed to matters at home, let the Council also turn their attention to countries far afield. There is spade work in plenty and much prejudice to overcome there—prejudice caused by the foolish, almost criminal policy of some breeders of the past, who dumped their rubbish overseas, where it was purchased by breeders who looked for typical specimens of the breed, and judged the breed as a whole by the standard of the screws they received.

To a lover of the Shire it is almost heart-breaking to see how the doings of the Shire world are either neglected or, worse still, misrepresented in the press of foreign countries. Remedy this. Take a lesson from the policy of the Percheron Society of America. Does advertising pay, you ask? Why, even governments advertise, and keep their publicity departments. An example of the wisdom of advertising in the horse world may be given. A few months ago the Percheron Society of Canada published a large supplement to "The Calgary Herald," one of their leading farm papers. This supplement was devoted entirely to advertising their favourite breed. We now hear that a shipment of 27 Percherons from the stud of one of the leading breeders in Calgary is on its way to our shores. Yet the powers-that-be in the Shire world slumber peacefully on, and, when disturbed, murmur sleepily, "All is well," and go to sleep again. Shire breeders, sound the *réveillé*, cast off the moth-eaten clothes of the old methods of wait-and-see, and gird on a new armour. Take up the weapon of resolve to place the Shire firmly on its rightful pinnacle, as the head of the equine world. There is room for all, let every breed take its place, but see that the Shire stands firm on top.

Some say that, with the coming of peace, there will be a great slump in the equine world, owing to the placing on the market of the thousands of horses owned by the Government. There are, however, two sides to every question, and this one is no exception. For one thing, can all the surplus horses of the Army supply the needs of the devastated lands of our Allies, without mentioning the requirements of our enemies, whose horse stocks will also be enormously depleted? Again, is it likely that even *our* Government will quite forget the lesson of the past and ever allow our Army to be so undermounted as it was when War broke out? How about the millions of acres of freshly broken-up land? If these are to be retained under cultivation, as we are told they are, will not a far larger number of horses be required for the cultivation of this land than in the days before the War? This causes us to think of the unprecedented drain on our own horse stocks, which will take some years to overcome.

Grant for a moment that such a slump should come, what type of

horse will feel it most? Surely not the Shire, who is, and always will be, in good demand wherever there is weight to shift; and least of all the pedigree Shire, whose mission it will be to re-invigorate and improve the horse stocks of the world? Other countries, in their endeavours to breed an active type of horse, have lost sight of the equally important quality—weight; and to give this weight to their native breeds it is to the weightiest of all, the English Shire, that they will look.

Stick to your weight, Shire breeders, and combine this weight with quality, and the Shire will be unassailable; but sacrifice either, and down to the depths the breed will go. Remember this fact, and let “weight with quality” be the slogan of the Shire in the battle of the breeds. Hang on to your best fillies, no matter how tempting the offers may be; use the best horses you can obtain, and above all use sound ones; remember that like produces like, and this is never so true as in the case of unsound animals. Adapt the old rule to your circumstances, and when contemplating a just useful colt, remember, “spare the knife and spoil a good gelding”; a good gelding always is in demand, but there are few customers for the moderate stallions which unfortunately too frequently appear. Bad stallions are a curse both to their owners and the breed, but good geldings are one of the mainstays of the breed, and few things are more profitable to their owner. The dawn of a new era is at hand, do your utmost, breeders, to ensure that it is an age of great successes for the Shire. The breeders of the past have given us a magnificent heritage; let us prove ourselves worthy to carry the standard of the Shire for ever in the lead. “GLADIATOR,” in *Live Stock Journal Almanac*.

Sheep as Cultivators.—*There has been a tendency during the war to under-rate the value of Sheep and the following article written by the late Professor Wrightson brings out one aspect of their value which ought not to be overlooked.*

Some years ago a series of papers appeared under the general heading “Unpatented Tillage Instruments,” among which were ranged earth-worms, moles, frost, weather, etc. The subject is capable of light and pleasant treatment, and sheep might well have been added to the list. I propose in the following remarks to exhibit sheep from this point of view, in order to show how a flock may be profitable in other ways than in cash returns.

The fact is, that if sheep were debited with all they eat and all they cost, they would probably in most cases be shown to have been maintained at a loss on arable land. And yet this would not seriously affect the question of keeping them, in the eyes of an arable land

farmer, because he would see through the figures, and reflect upon the work his sheep do for him. He might, in fact, regard them as labourers worthy of their hire. This view is, I maintain, especially sound in the case of light land, but becomes less clear on heavy clay soils, where the treading of the sheep in winter may do harm. It is however, not only to the beneficial effects of close folding on light soils that attention is now directed, but to the great loss which would ensue if the flock were removed, so that it might obtain keep at a distance, or, worse still, if it were relinquished. We have heard a good deal of the possibilities of continuous corn-growing, and of the expenses of root cultivation, and sheep husbandry; and some have even been tempted to get rid of some of their sheep. It is to this point that I wish to direct attention at the present time.

It is true that many classes of land might be capable of producing marketable crops to a greater extent than they do now. Roots might, for example, be sold, and replaced by purchased fertilisers; but on light lands, on which sheep are justly looked upon as the sheet anchor of successful farming, the flock would soon, and very soon, be sorely missed. There is a great deal of truth in the expression "a working flock" for work it does, and when ewes disappear off a farm it is equivalent to the loss of a number of labourers. Let us glance at the class of work sheep perform. A flock, of course, consists of many sections, and, as in human populations, most of the work devolves upon the parents; so, in a flock, the ewes do the work and the lambs play. It is practically impossible to state the cost of keeping a flock of ewes, and the return comes principally through the lambs. There are, it is true, draft ewes and wool; but the sale lambs are the real source of revenue. Draft ewes come out depleted in numbers and reduced in value, and ewe lambs are saved to supply their places and keep up the normal value of the flock. The flock, therefore, represents capital, and the usual draft is a mere set off against the expenses of maintenance.

The point before us is the instrumentality of the flock in keeping the farm trim and in good order, and in eating food which would otherwise be wasted or ploughed in. The value of a flock in these respects is incalculable, as may be best shown by following them in their work throughout the year. Lambs intended for sale ought to have the first chance on every successive crop. They cannot be compelled to eat up everything, or make what is called "clean work." The stock ewes may, however, always be relied upon to come in at the finish, and clear the ground of stale stuff which would otherwise be wasted. This food has no marketable value, and could

not be let as keep, even for ewes. It is, however, sadly in the way, and many a small farmer who has no sheep of his own will thank a sheep master for sending his ewes to eat it off. Of this I have had experience, as also of the serious gap in the economy of a large light-land farm if ewes for any reason are away on keep for a lengthened period.

The effect of a mass of vetch haulm left on the land by lambs is bad for the next crop. It renders the land dry and hollow, and ought to be eaten or burnt. The flock saves the farmer from this last expedient, which is at best a bad one, as it dissipates nitrogen. Ewes are equally useful in clearing rape, cabbage, and root land, after the more pampered sections of the flock have consumed as much as is good for them; and the residue is of no assessable value, but is doing harm in the same way as vetch haulm does.

As soon as the lambs are weaned, the stock ewes are available for this class of work, and can be so employed up to the eve of lambing, i.e., for most of the year. Towards the close of summer old seeds and sainfoin, as well as pastures, become unkempt and ragged, and if it were not for the stock ewes they would keep so, and, in the case of leas intended for wheat, the consequence would be a hollow furrow harbouring wire worms and other pests. It is important that long and old grass should be eaten down bare, and left in the form of manure instead of as old herbage; and this the flock does for the farmer. It also has no assessable value, although a small sum might be given for it when keep happens to be scarce. It, however, more frequently happens that when there is an excess of old grass left on one farm the same conditions prevail throughout the district, so that the farmer must rely on his own flock for consuming it. Ewes run over these grazings, and convert waste herbage into valuable manure. They also go gleaning in the corn fields after harvest, eating up stray ears of oats and barley, which would otherwise be lost. They find a living where forward lambs would starve; and the best of it is that, on the whole, they are better for work and exercise, and ought not to be in too high condition. Most large farms abound in ewe-keep after midsummer, when the hay crops have been secured and the fogs and aftermaths are becoming old and worthless.

As stated at the outset, the flock would be sorely missed if it was removed, and it is difficult to think of any other agency which would take its place. What would be done with the remnants of food, after the lambs have passed on, with the leavings of rape and cabbage crops, the stale overgrowths of seeds and sainfoin, or the stray ears left on stubbles, if the ewes were gone?

As to the actual cost of maintaining a flock of ewes per head per week, it is in itself trifling, although the cost of keeping sheep, as a whole, may be heavy. The ewes incur only a small share of these expenses, which ought to be charged to the lambs. Ewes work for their living, and it is to them that a large farm owes its neatness and in a great measure, its fertility. They should not be charged for artificial foods, because it is given on account of the lambs. The most serious expense in keeping ewes is hay, but this can almost entirely be dispensed with by the use of straw and rough grazing.

The profit, or rather the advantage, of sheep cannot be reduced to a cash statement. There is the benefit accruing from the ewe flock itself, but there is also that of the close folding of both ewes and lambs. It is impossible to reduce these items to a monetary standard, because they are all founded upon estimate and expectation. Still, if anyone will consider what his sheep are doing for him in respect to his whole system of cropping, he will find something like the following rough estimate to approximate facts. With the aid of sheep, poor land, which could not produce more than 24 bushels of wheat per acre, may yield 48 bushels. Similarly, the barley crop will be increased from 24 to 48 bushels; the oat crop from a poor crop of 40 bushels to 60 or 80; clover hay will yield 1½ to 2 tons instead of half those amounts, and all the root crops will be incomparably better. It would be a mistake to attempt to reduce these gains to figures or to represent them in a system of books. They are best arrived at by thinking the matter out and fixing reasonable figures to represent what each farmer thinks his sheep do for him when folded on his land.

The preceding remarks will show how inextricably the flock is entwined with the interests of the farm. It is at once a land-presser, a lawn-mower, a fertiliser, and a manure distributor in one—a many-bladed, self-acting machine, trimming rough herbage that no cutter could reach, levelling water-meadows in spring, and preparing clover leys for ploughing in autumn—acting as a scavenger of waste herbage all the summer, and gathering up the fragments and hollow shells of swedes and turnips all the winter. A flock makes short work of clover fodder, and at once proceeds to demolish many flowering weeds. It may be used to firm hollow land for young wheat, and to check the exuberant growth of winter-proud corn. It is one of the best checks to wire-worm. It trims gorse bushes on fells and downs; discourages the development of coarse grasses, and stimulates the growth of purer and sweeter herbage. A sheep has been described as a “portable manure cart,” and a flock saves no end of labour in dung spreading. The saving of

horse labour by sheep is even more important than the saving of manual labour, for they do away with the necessity of carting roots home to the steading, and manure back to the field. They also save rolling and harrowing, for they drag their feet over clods and trample them under at the same time. If a sheep account was actually debited with every cost, it ought also to be credited with the actual work it performs—as also should the crops be debited with the advantages they receive. One of the best land valuers I ever had the privilege of working under told me that he considered land that would carry sheep to advantage was worth £1 an acre more than the same quality of land which would not. Hence it seems clear that one of the uses of sheep is, as declared in the title of this article, that they are Instruments of Cultivation. It would make no difference if sheep, as a matter of account, were brought in as losers—but such a result would show that the profit of sheep-keeping on arable land is not to be measured in terms of cash, but on a much wider basis.

Principles Governing Manuring.—Before one can properly understand the manuring of crops it is necessary that one should grasp the governing principles. Lack of knowledge was a fruitful source of controversy in former years, till a series of remarkable experiments demonstrated what elements were essential to the growth of a plant. By essential elements we mean those which are necessary as plant food which are needed for building up the protein, carbohydrates, &c., which give crops their feeding value. Fortunately the farmer does not need to supply all these elements, because, excluding nitrogen, potassium, phosphorus, and calcium, they occur in sufficient quantities either in the air or soil to prevent the necessity of their application. Thus the farmer's manuring is practically reduced to four elements, and the effect of each of these on the crops will be briefly dealt with.

The element nitrogen is necessary for the production of adequate leaf and stem, and also for grain. Experiments at Rothamsted have demonstrated that the yield of grain is very much reduced when nitrogen is withheld, and also when excess of nitrogen has been applied, but the main reason for application is owing to its "growing" effect. Nitrogen when supplied to any crop increases leaf production to a remarkable extent. It gives the plant a luxuriant green colour, and tends to delay ripening by prolonging the growth. Plants, like cabbages, in which leaf production is important, give a very much increased yield, but the tissues are softened by the treatment, and they are apt to get badly bruised on being marketed.

On applying nitrogen to cereals it must be remembered that those crops which are cut dead ripe should not receive a dressing, and in any case the latter should be small or the crops have a tendency to "lodge." Root crops do not, as a rule, receive much nitrogen owing to the delay at harvesting and also the excessive "shaws." In those crops, however, in which the growing period extends far into the winter, there is no doubt that the roots are larger. Nitrogen is supplied in various compounds by manufacturers. Nitrate of soda, nitrate of lime, sulphate of ammonia and nitrolim all contain a considerable percentage of nitrogen, which is in varying degrees of availability to plants.

Phosphorus is supplied in superphosphate, basic slag, bone manures and guanos. The most striking effect of phosphorus is that on root formation. During the early life of the plant the roots show an increased development when these manures are applied. This is of great importance in root crops. Turnips, potatoes and mangels are all benefited. While they are at the seedling stage the roots ramify through the soil, get a firm hold, and are able to tap supplies of food which otherwise would have been unavailable. To crops which have a restricted root range, like barley, an application has the same effect. Phosphates are also applied to other cereals in northerly latitudes to hasten the ripening. This fact was first demonstrated at Rothamsted, where it was found that "crops receiving phosphates are golden yellow in colour, while the others are still green." Phosphates also seem to raise the quality of pastures and increase the feeding value of the grass.

Potassium is the source of value of all potassic manures, such as sulphate of potash, muriate of potash, potash manure salts and kainit. Potash seems to be essential for the maintenance of vigour and health in plants. At Rothamsted in those plots which never received potash the plants had an unhealthy appearance and readily succumbed to disease. Potash facilitates translocation of manufactured products in the plant. It is therefore of great value when applied to potatoes, sugar beet and mangels, and all roots in which starch formation is of importance. It is found when potash is withheld from these crops that the formation of starch comes to an end. It has hitherto been difficult to find a reason for this peculiar action, and no satisfactory hypothesis has yet been suggested. Potash also exerts an influence on the size of the grain. Hellriegel found when he was experimenting with barley, that rapid increases of weight of grain were the result of increased supplies of potassic manures.

The three essential elements—nitrogen, potassium and phosphorus

—when supplied as manure, form a complete manurial dressing. But for the maintenance of fertility the soil must have applications of lime, unless it is a chalky soil or contains a good percentage of lime.

Calcium is the main element in all lime compounds, such as chalk, ground limestone, shell lime, &c. Lime is necessary for the maintenance of healthy conditions in the soil. It is an antidote to acidity, and thus very seldom fails to check the dread “finger-and-toe” in turnips. In all reclamations of peat and moss-land lime is always employed. In clay soils, apart from its alkaline nature, it acts as a flocculating agent, and thus makes them easier to cultivate. The part it plays in the plant is not so evident, and the resulting vigour of the crop after an application of lime to the soil seems to be the result mainly of better soil conditions. The tendency of present-day farmers is to neglect lime entirely, yet nothing repays the farmer better than a periodical dressing of lime on the soil.

There are many other conditions to which the farmer must give attention before deciding on the manurial mixture to be applied. Of these, perhaps the most important are the soil and crop. Manures which would do well on one soil would perhaps have a deleterious effect on others, and the same with crops. There is no better method of getting desirable results than by practical experiment.

Colleges issue average results of experiments over wide areas, but these are of greatest value when confirmed by a personal trial. No two soils are alike in situation and composition, and it is to the farmer's own interest to see that his land is upholding its fertility and giving the best crops.—*The Scottish Farmer.*

The Percheron.—The year 1918 has marked the formation of the British Percheron Horse Society, under the presidency of the Earl of Lonsdale. He and those acting with him have not been accustomed in the past to associate their activities with inferior or unwanted breeds of horses. Rather have they been identified with striking successes. Furthermore, the Society was launched with the blessing of those who sit in authority under the Government and whose business it is to administer what limited State funds are allocated to national horse-breeding. The War Office has also extended a welcoming hand to the new Society.

In France the Percheron breed of draught horses flourishes because it is highly esteemed by the French Government and agriculturists. In the United States and Canada it prospers exceedingly, and though it has extended to great dimensions in recent years, it is still expanding on a scale which could scarcely have been anti-

cipated forty years ago, when the movement across the Atlantic was in its pioneer stages. I have sufficient faith in the horse and those connected with the British Society to have no doubts that the breed is destined to take a big place in this country. I see, indeed immense possibilities before it for the very good reason that the Percheron's qualities of weight-pulling, activity, soundness, docility, and courage are simply irresistible and must overcome the inherent prejudices of the naturally conservative horse breeders and users of the United Kingdom.

Now, how comes it that amid all the distractions, tragedies, and anxieties of war there should be brought into existence this new British horse-breeding society? The answer to that question supplies the *raison d'être* of the Percheron's coming under such influential and authoritative auspices. The origin of the movement—and everything that has happened since traces back to it—was the Army's intimate association with him, an association which made the horse absolutely indispensable to the mobility of our Armies in Western Europe and practically in all other theatres of war. When one understands that the mobility of vast armies is the whole key-spring of manœuvre and successful operations in the field, he will appreciate why the horse has taken such a big part in establishing the success of our arms in France. They were bought in thousands in the United States, and in a lesser degree in Canada, and they found their way to our wonderful array of horse-using units in France via the United Kingdom. That, briefly, was the way knowledge of their virtues came to spread.

So far as the War Office is concerned, therefore, the Percheron has now won his spurs, as one may say, since the vast majority of the war horses we have imported from America have been Percheron-bred, or, as the American breeders call it, Percheron-graded. At any rate, the Percheron is the predominant blood in the heavy-draught and light-draught horses which have been put on the "ration strength" of our Armies. The point of view of the War Office is that the Percheron is the ideal horse to introduce a strain of strong, active, short-legged, and hardy gun-horses to this country. There were very few such in the country at the outbreak of war, and home-bred ones practically do not exist to-day. That there may be no more wars after this is the prayer of everyone, but doubtless for some years to come there will be a necessity to maintain a certain standing army, the size of which will have to be determined by the nature of the peace settlement.

Therefore it will be understood that the War Office was interested in the importation of the Percheron breed to England. The War

Office has no control whatever over money expenditure on national horse-breeding. It can only express its needs in emphatic terms and press and urge its demands on the responsible Government Department, which I take to be the Board of Agriculture. Therefore all the War Office could do, through its Director of Remounts, was to mark its unofficial approval of a step in horse-breeding which was calculated to place more horses of the required type at the disposal of the Army in the event of further demands being made.

All the experiences gained among horses since the war began, all the testimonies of responsible commandants of artillery brigades, divisional ammunition columns, and transport generally, were unanimous in praise of the Percheron-bred draught horse from America. Hence the far-reaching importance to the new Society of War Office approval, with its promise of encouragement and assistance in time to come. But apart from that and the purely patriotic motives influencing the Percheron pioneers in England, there was a commercial aspect of very real importance. The heavy-draught Percheron, such as has been imported from the fields of the Perche in France, has, I venture to say, qualities which no other heavy breed in this country can surpass. That is, of course, a matter of opinion, but it is one which the Honorary Secretary of the British Society, from experience which is only given to the few, is fully entitled to express.

I hope my statement will not provoke reprisals from gladiatorial champions of the Shire, Clydesdale, or Suffolk. There is no intention, so far as I am concerned, of hurting their susceptibilities. If the Percheron horse for the land and the cities comes here and conquers, they will be the first to know about it, though they may be the last to admit it. I do not expect them to share my abundant faith, but I know that I do not read the signs wrongly, and that the Percheron is making friends wherever he goes. France cannot supply our demands to-day. Naturally they are anxious for their own pure breed after these years of constant supply to the armies in France. But there are the United States and Canada to turn to for their horses of pure French Percheron descent, and most assuredly they will come here in considerable numbers the moment shipping is released.

In a very few years, therefore, there will have grown up in this country a new breed of draught horses, which is certain to establish itself firmly and in favour with all classes of users of heavy horses. They will appreciate him for his wonderful docility and rare courage, and, most important of all, they will rejoice in his clean, sound, "featherless" legs and the immunity they give from those cursed

leg troubles which have been the bane of the feathered-legged horses on active service in France. They will rejoice, too, in having a horse which will on the same ration or even a smaller one, do more work, get over the ground quicker and show more for the day's work than any breed with which I am acquainted. In spite of difficulties high-class stallions and mares have been arriving in England during the last three years. The demand now is far in excess of the supply. From being to-day a comparatively small but influential corporation the British Percheron Horse Society will become one of the leading breeding societies.—CAPTAIN S. GALTREY in *Live Stock Journal Almanac*.

Farmers and Farming in 1918.—The year 1918 will be remembered as that in which England not only fought for her life, but also struggled to produce the food without which she could not live. It was that diabolical instrument of destruction, the submarine, that was to bring us to starvation, and just how near it was to succeeding the world may never know. Three forces combined to save us, the Army on land, the Navy at sea, and the men at home who cultivate the land and produce flocks and herds, corn and milk, and it is to them we pay a tribute here. Government Departments may take unto themselves credit for the wisdom of their policy and their multitudinous Orders; but, after all, it is the workers who have saved the situation, the farmers, labourers, women, gardeners, and allotment-holders, who were all joined together in one great effort by the law of patriotism and self-preservation. Let it be said to the credit of farmers that they stuck to their task in face of overwhelming difficulties and in spite of unjust criticism.

At a period when, as well as the patriotic, the selfish side of human nature has displayed itself, when labour has revolted at critical moments and capital has profiteered to an unfair degree, the farmer never downed tools, though more than once he had reasonable justification for doing so. The cattle in the country at the close of the year, the corn in the barns, the hay in the stacks, the potatoes in the clamps, the daily milk flow, the thousands of allotments carrying useful food crops, all bear testimony to the victory of the producer in the battle for food. In short, the farmer has carried on despite the jibes of irresponsible fanatics, and if he has secured some share of the commercial prosperity which has been brought about by circumstances that he would have avoided, if possible, it is nothing more than a just reward for his efforts.

The circumstances of the war are responsible for the passing for the time being of that freedom and independence which have

always been the boast of farmers. To-day farmers are tied and bound by the chain of Regulations and Orders issued under the authority of D.O.R.A. They provide the capital, yet they must use it as Government Departments may direct, but the spirit of yeoman independence is only sleeping, and with the declaration of peace it will awake and farmers will farm again as their practical knowledge and experience may direct, or know the reason why. We can see now some results of the great ploughing-by-compulsion campaign of last winter, and while the supply of cereals has been augmented to a commendable degree, we cannot overlook those hundreds of acres of land that have produced nothing, not a ton of hay nor a grain of wheat, but on which bushels of good seed have been wasted through a lack of wisdom on the part of those who were given the responsibility of dictating which land should be ploughed up.

Some of us are wondering, if this policy of ploughing up is persisted in, what will be the state of the land in ten years' time, unless very careful judgment is used. Under Orders the farmer must do as he is told with the corn he has grown, and must have a permit even to use that which is damaged to feed his hungry stock. When, in face of great difficulties, he had got beasts fit for the butcher, they were sent back from the market to await further orders and lost weight, and he is so hedged round with officialism that he can make no plans for the future. There is one redeeming feature about it all—probably the ownership of land will never again give a landlord the right to do as he likes with it, and in the agriculture of the future there will be no room for the reputedly bad farmer. These changes for the better can be brought about without friction and tyranny, and the sooner after peace is declared the great army of officials who are worrying and harassing farmers are instructed to seek other jobs the better.

What has proved to be the last year of the war will be remembered as being a great land-boom period. Thousands of acres of land have changed and are changing hands, often at unheard of prices. Titled nobility have parted with estates which have been in their families since the Norman Conquest, presumably because they consider it good business to sell. Sometimes we wonder how the purchasers are going to obtain interest on their money in the future. The men who are caused anxiety by these changes of ownership are the tenant farmers. While the Board of Agriculture can turn them out of their holdings for what a War Executive Committee describes as bad farming, yet it has no power to protect them from being turned out from the holding being sold over their heads, no matter how well they may have farmed.

Many a farmer has impoverished himself to buy his holding rather than be turned out of home and occupation, and, owing to the prices some have paid, these farms may hang like millstones round the necks of the occupying owners and their families in years to come. We do not blame landlords, who have been hard hit by the war, for selling their land; but we contend that a tenant who is farming well should be protected from unreasonable disturbance in consequence of the transaction.

Looking back over the events of the year it is a wonder farmers have got through so well. Those who promptly obeyed orders the previous autumn, took time by the forelock, and got their wheat sown in the fall, have good reasons to congratulate themselves that they did so, and we have learnt another lesson about the autumn sowing of wheat being the soundest policy. Oats on spring-ploughed land gave good results in many cases, and the black spot on the cereal year was the harvest time. Fortunately, in the southern half of the country, most of the wheat was harvested before the fine weather broke up at the end of August; but since then the story has been a sad one, and it is only repeating a well-known fact to say that the anticipated results of the Governmental ploughing campaign were to a large extent defeated by the unfavourable harvest weather.

Hay crops were light, in consequence of the dry summer, but the hay was made well. The story of roots is not a pleasant one, as mangolds in many cases germinated badly, and the protracted drought in the summer was fatal to swedes, though fortunately the rain came in time to get some turnips.

The appeal to grow more potatoes was readily responded to, and the Government set up a big machine, requiring we don't know how many officials to work it, for distributing the crop. Some wonderful crops of potatoes have been grown on land that was turf a year ago.

After the wonderful fruit crop of 1917 anything like a repetition could not be expected, but no one anticipated quite such a failure as was experienced in 1918. The comparatively few growers who had plums, apples, and pears never made anything like the money for them before in their lives. The experience of war time has demonstrated the value of fruit-growing as an industry, and emphasised the importance of planting and maintaining orchards on grass land in those parts of the country where apples and pears will grow.

The year has witnessed the establishment of Wages Boards and the fixing of labour wages at a level which nothing but the maintenance of similar high prices for produce can stand. We have yet

to see whether the standardising of wages by the State will be good in the long run for either masters or men. The women have done well, and, despite the fact that many Land Army recruits found themselves to be round pegs in square holes, we have nothing but praise for those who have stuck to it. Thanks to the release of men in khaki for work on the land, the shortage of labour has not been felt so acutely as it might have been, and in common fairness it must be said that the prisoners of war employed in agriculture, have, generally speaking, given satisfaction.

Co-ordination is a thing that is lacking in Government Departments, and we have reason to deplore the absurdity of one Department being responsible for the production of food, while another was governing the price of it and supplying the necessary material, such as feeding-stuffs, for obtaining the food. Everyone remembers the Government's appeal, made in the spring, to produce more pigs. It is safe to say that no appeal made since the war began was responded to more loyally, and no patriotic section of the community has been let down more badly than pig-keepers. For a time the Ministry of Food attempted to distribute the available feeding-stuffs by means of more or less useless Priority Certificates, then it was officially announced that after November the ration for store pigs would be 1lb. of meal daily per head, and that after January, 1919, there would probably be none at all. This announcement spread dismay amongst pig-keepers; pigs which were worth £3 in May could now be bought for half a crown, and farmers were at a loss to know what to do with the litters as they were born. One law prevented their slaughter, and another gave their owners practically nothing to feed them on. Lack of shipping to bring feeding-stuffs as well as troops and munitions was given as the cause of the trouble, but in the meantime people could buy American bacon without coupons, and, it being obvious that such bacon was not raised in a few weeks, public opinion was led to think that American Meat Trusts had something to do with these orders.

Pigs were not the only animals that suffered, for horses had a bad time. Stocks of poultry became so reduced through lack of food that eggs, before prices were fixed, fetched 8d. each in the market. The Ministry of Food never took farmers into their confidence as regards the actual situation respecting feeding-stuffs, but explained that it was necessary to stint other stock in order to provide a supply for milking cows. Farmers chafed at the restrictions which prevented them using their dredge and tail corn for feeding, and their just complaints eventually led to some concessions being made.

British pedigree stock—cattle, sheep and pigs—still stand pre-eminent, and the record prices made at sales promise well for the demand for pure-bred stock.

Amongst the good results that have come out of the evil of the war, there is the conviction among the farmers of the country that they must combine in their mutual interest. There is need of more unity of spirit, greater co-ordination and intensity of purpose, less talking about things of minor importance, and a broader outlook on things which affect the industry as a whole.—“RUSTICUS” in *Mark Lane Express Almanac*.

Green Manuring.—A good texture of the soil is but one of many important factors that enter into that most complex problem of how to keep up the fertility of the soil. There are thousands of acres of land that produce indifferent or unprofitable crops for no other reason than that the soil is poor in texture. Land is of good texture when it is in the right physical condition for growing crops. This means that it possesses the qualities expressed by such common farm words as mellow, loose, friable, porous or easy to work. It does not depend upon the mere richness of the soil in plant food, but is concerned with the way in which that plant food is served to the growing crops. It does not mean the amount of water that a soil contains, but it does mean the facility with which the water is presented to the crop. Good texture means that the machinery of the soil is well oiled and in running order; not that there is plenty of raw material—plant food—in it, out of which a profitable crop can be manufactured. In the language of the farm—the texture of the soil is the way it “works up,” and exactly what is meant by that is known to everybody who has handled soil at all. There are several ways of putting good texture in a soil that has become cloddy, but the most practical way usually is Nature’s way—to keep it filled with humus.

“Humus,” “green manuring,” and “good texture” express three agricultural ideas that are doing much to improve our farming, and at a very moderate cost. No one who grows crops can afford to be ignorant of their significance. The best illustration of the use of humus is a piece of virgin soil. Here, for centuries, have grown grass, herbs, shrubs and trees. During ages plants have grown to maturity, reproduced their kind, died, decayed, and returned to the soil. Each year the soil becomes richer from the return of its produce. It may thus come to have upon it great trees, standing so high and so thick that we wonder how such a thin, rocky soil can support them. Then a farmer clears the land, uproots

the stumps, subdues the herbage and plants grain. For some years the crops are large, but after a time they begin to fall off. The farmer then seeks to maintain his yield by applications of manures. These help to some extent, but do not seem to restore the land to its early reproductive power. The farmer wonders why his small crops of grain exhaust the soil more than the great forest crop of Nature's farming. The few bushels of corn that he raises on an acre each year cannot take out of the soil a fiftieth part of the plant food that was needed by the lofty trees and the carpeting herbage of Nature's crop. He takes a sample of his soil to be analysed. The chemist's report is that the soil contains enough of all the necessary plant foods to grow full crops for many years. Yet the yield has fallen away considerably, and the application of fertilisers, though improving matters, does not produce the desired result.

It is decaying vegetation that his soil needs. The farm has been cropped with grain and roots for years. No vegetation has been restored to it except the stubble and roots of the grain, the tops of the root crops, and a few weeds. For years the soil has been exhausted of its vegetable matter. No wonder the soil gets harder to work each year; it needs more of this decaying matter to separate the particles and make it looser and more mellow. It suffers more from drought than it used, because it has not enough humus in it to hold the moisture. It is the lack of decaying vegetable matter more than the deficiency of plant food that is responsible for a reduction of yield. Hence the value of green manuring. When a plant decays in the soil it returns to the soil practically all that was taken from it. But there are additional benefits. During the decay of the plant there are formed certain acids that help to dissolve and make available some of the plant food in the soil that is in a form unsuited to the plant. This is a very important office. Moreover, if the plants grown for making into humus belong to the class called legumes, they may materially enrich the soil in the valuable food nitrogen. There are other scarcely less important means of improving the texture of a soil, and hence increasing its productive powers. These can be merely mentioned here. Application of farm manures of various kinds is the very best treatment that can be given. Manures are usually valuable, fully as much for the humus they contain and for their beneficial effect on the texture of the soil, as for the actual plant food that the chemist finds in them. Every farmer knows that there is no quicker way of getting a "hard" piece of land in good heart than by dressing it liberally with manure. Thorough tillage improves the texture of soils by breaking up the lumps. A common mistake in farming is lack of thoroughness in

the preparation of the soil for planting. Three more harrowings might increase the crop as much as several bags of artificials. Under drainage also improves the texture of soils. If soils are too wet in wet times, and baked in dry times, they need drainage. Some soils do not satisfactorily respond to manurial dressings simply because their texture is bad owing to poor drainage. *-Farm and Home.*

Hop Growing.—*The cessation of war will probably give a fresh impetus to the cultivation of Hops, hence the following article, though written some years ago, may prove of special interest to our readers.*

The modern hop-grower carries on his business on very different lines to those of twenty years ago, and it must be admitted that a considerable amount of the improvement of the practice is due to the scientific investigations which have been carried on. The German grower even now, when an attack of blight appears, is inclined to fold his hands and do nothing to stay what he thinks is a dispensation of Providence—this apparent apathy may be due to the fact that with his tall poles, washing presents serious difficulties.

It is the intention of the writer shortly to state the main points in which modern hop-growing has made advances on the old system and to indicate lines on which further advance may be made. Each country and each climate favours the production of a variety of hops, which possesses certain characters of yield and of quality, which characteristics may not, and probably will not, be secured by growing the same variety under different conditions. The fine flavoured Saaz hop if grown here will not retain its characteristic flavour, whilst many of the German varieties if grown in this country tend to coarseness, which renders them useless for the brewing of light fine flavoured beers.

The breeder of new varieties seeks to produce a hop of good yield and satisfactory quality, and if we can introduce into the heavy yielding and robust character of some native hops, the delicate flavour which characterises some of the Continental varieties, without sacrificing constitution, good results will ensue. The failure in the cotton-growing industry, of the earlier workers to produce satisfactory results was due to an attempt to acclimatise fresh imported varieties to new conditions; later workers have taken as the basis of their work of improvement the already acclimatised native varieties and by the introduction of foreign "blood" of the desired qualities have produced a plant of satisfactory yield, staple and constitution. The same plan is being followed with regard to hops. The new varieties of considerable value which have hitherto been brought out are the result as a

rule of a "sport," and these have been perpetuated by cuts or vegetative reproduction, and are not raised from definitely bred seeds.

The question of the utility, or the reverse, of the male hop in gardens has now been definitely decided, and it is recognised that the fertilization of the female hop induces "growing out" and reduces the risk of mould, at all events in this country. In Germany the varieties grown do not seem to require fertilization for efficient "growing out." It is, however, important to select male varieties, the pollen of which is distributed at the time when the female flower is ready for fertilization, and it may be that several male plants, which will flower at different times, are required in a garden, in order to catch all the female flowers, and it is estimated that one male to every hundred hills is the proper proportion.

The modern system of training hops, shows very considerable differences from that in force some twenty or thirty years ago, when nearly every garden used poles, which are now supplanted by wire work, which is erected permanently, the hops being trained to climb on strings at an angle of 45 degrees. The cost of setting up and taking down the poles is avoided, but there is a preliminary expense in putting up the wire work, and an annual expense in stringing, and in training, the latter during a windy season being sometimes considerable. There is more knowledge of the requirements of hops in the way of manure, and far less "firing at the brown" than was the case in past years. This is rendered necessary by the lower average price for the produce, so that economies and discretion in the choice of manures have to be observed.

The hop is an all-round feeder, and requires a complete manure—bulky organic manures, shoddies, fish and meat guanos, and of course farmyard manure are most in request—phosphates tend to induce an earlier maturity, whilst an excess of nitrogenous manure, especially if applied too late, is apt to cause a luxuriant growth of bine, which may not only delay ripening, but may cause the plant to be more damaged by attacks of mould. The defect which is noticed in a good many gardens is in the insufficient supplies of lime to the soil, and in the case of hops where large quantities of nitrogenous manures are applied annually, it is important that the percentage of lime be maintained in order to secure the absence of sourness from the soil, and the availability of the inert nitrogen accumulations, and in the case of light sandy soils, a sufficiency of lime in the soil is an essential consideration.

The cultivation of the hop-garden in the hands of experienced men has not undergone much alteration during the last twenty

years, and the necessity of frequent stirring of the ground in order to secure a healthy growth of the plant is well appreciated, as unless the plant is maintained in a robust, growing condition, an attack of insect or fungus may have very serious results. In the employment of measures to combat these insect and fungus attacks, much knowledge has been accumulated, and progress has been made, but there is much more to be done, both in investigation work, and also in disseminating the knowledge which has been already obtained. The chief insect pests attacking the hop are the Hop Aphis, Stem-eelworms and Red Spider; and for the destruction of these the modern hop-grower must be prepared both in knowledge and equipment. The Aphis and Red Spider are combated by washing the hops with suitable insecticides, soft soap, with an admixture of nicotine, quassia, or liver of sulphur being generally employed, and the solutions applied either by a washing machine drawn by horses through the garden, or, by means of a steam pump, the solution is forced through portable hose pipes. By the latter system special attention can be directed to any plant or part of the garden where the wash is particularly required; whereas, in horse washing it is difficult to bestow more attention on a particular plant than on others.

For the destruction of the Stem-eelworms, which according to some authorities are the cause of nettlehead, the grubbing and burning of the affected plants, and a treatment of the soil so as to secure the eradication of those worms left in the ground is necessary. Wire-worms are also a serious trouble in hop-gardens, and they must be attracted and trapped, as no treatment of the soil seems adequate to ensure their destruction.

The spraying or washing of the hops for lice and fly must not be postponed in the early part of the season, but commenced directly the vermin appear, as the rate of propagation is very rapid and the attack may easily get beyond control. The winged form of the aphis does not usually continue arriving much after July, and every effort should be made to wash the plants thoroughly clear of the fly before the hops begin to show, as it is difficult to get at the fly when the cones are formed and the presence of dead flies or their excreta in the cones is very damaging to their value.

The chief fungus attack to which hops are subject is "mould" and as this attack is most serious, as regards the development of the hops when the hop is in burr, the first advent of mould must be immediately dealt with. The method of dealing with mould is by blowing sulphur (by means of a bellows drawn by a horse, through the garden) on to the plants, the early morning being the best time

to conduct this operation, when the dew on the leaves causes the sulphur to adhere. The exact action of the sulphur is not known. Another fungus disease, which may cause very serious damage to the plants, is hop canker, and the occurrence of this on particular varieties is being investigated.

Considerable improvements have been made by manufacturers in the construction of the cultivating washing and sulphuring machines, attention being paid to lightness of draught and to the character and efficiency of the spray by the improvement of the nozzles. The next point—the picking—is one which requires a great deal of judgment and experience as to the readiness of the hops for the operation. The condition of the hops as regards ripeness is denoted by a definite characteristic such as colour, amount of “lupulin” present, mechanical condition or texture and condition of the seed. Unripe hops have not the quality of ripe hops, they contain more water and so shrink in weight more in the drying; whilst over-ripe hops tend rapidly to become discoloured and have not the greenish-yellow colour which should obtain.

Picking is always in this country done by hand—in America a hop-picking machine has been introduced, but the reports received of its work do not seem satisfactory enough to encourage growers in this country to use it. A properly-organized hop-garden contains a series of varieties ripening in succession, so that each variety comes to hand at its best time and in its prime condition; but there are of course occasions when, owing to weather conditions or an attack of fly or mould, the judgment of the grower has to be exercised whether it is not better to pick his hops, even though they are not fit, rather than delay the picking and consequently harvest a badly-damaged crop.

In the drying of hops a great amount of experience is required, and judgment as to how differing conditions which may arise are to be managed. A great amount of money, labour, and skill may have been employed in growing an almost perfect crop, and this an error in judgment at the time of drying may entirely ruin. The drying of hops used to be entrusted to expert hop-dryers who ruled in the oast-house like veritable tyrants during the time of the operation, and who worked to a great extent by rule of thumb. They were extraordinarily clever in producing the desired result without in a good many cases, being able (or perhaps willing) to give reasons for their practice.

Recent investigations have put the knowledge of hop-drying on a more definite basis, and although judgment and experience are essentials, there are more data by which we can regulate the process.

At the present time there are two systems of drying : (1) by means of the direct heat of an anthracite fire burning below the hair cloth on which the hops are spread, all the products of combustion passing through the hops, and (2) by means of a current of hot air, the volume, temperature, and purity of which can be controlled, the air being heated by a furnace in which any combustible materials can be burnt as a source of heat. Either method may produce excellent results according to the management—the direct fire method gave a handle to those who wished to raise a scare about arsenic in the hops—a scare which was proved to be without any serious foundation—but if the important points of temperature and efficient ventilation to remove the reek or the moisture arising from the drying hops be attended to, either system may give perfectly satisfactory results. It is obvious that any system of drying necessitating a somewhat high temperature may cause the loss of some of the volatile aromatic constituents of the hops, and attempts to improve drying processes should be in the direction of using a lower degree of heat in a different method of dessication.

Ventilation is effected either by a natural draught through openings in the oast, or by means of a forced draught caused by fans. The temperature must be low at starting, rising to 140–150 degrees Fahrenheit, and being allowed to fall to about 120 degrees at the close of the operation, which may last from eight to ten hours, and in some cases even longer. In Germany the hops are air-dried by the growers, who, as a rule, do not grow sufficient to warrant the establishment of a drying plant on their own premises, and are carried in this half-dried condition to the merchants who grade them and finish the drying in their own warehouses. The English grower sulphurs his hops during the drying, by burning sulphur in the oast, the contention being that the time required for drying is less, and the hops when dried are not so liable to mould as when sulphur is not used. When the hops are dry they are carefully moved from the hair floor, and in this moving, attention is directed to preserve the hops as far as possible from breakage, this being sometimes accomplished by the use of a rolling hair floor on which the hops are wound off on to the cooling floor where they rest for eight to ten hours, so as to get a uniform distribution of moisture, and then are packed in bales weighing about $1\frac{1}{2}$ -cwts.

The modern up-to-date hop-grower must be a man of capital and of a resourceful intelligence, one who can bear the fluctuation of the market and the varying conditions of his industry with courage and equanimity. Hop-growing is one of the intensive forms of agricultural production, and requires a considerable concentration

of capital ; in round figures an acre of hops will cost £50 to produce and market, and as to the returns, it is sufficient to say, that the price of hops has varied in the last thirty years between the limits of 30s. and £20 per cwt. The average yield also varies considerably—of the finer varieties of Goldings from 10–15 cwt. is a good crop, whilst of the coarser and more prolific Fuggles 20–30 cwt. may be harvested.

The extinction of the hop industry would be a real calamity to the country, it provides considerable employment, not only to the country dwellers, but also to large numbers of town inhabitants who are thus able to take a healthy and remunerative holiday. Pure beer of which hops are an essential factor, is always *associated* with the healthy self-reliant and tough English character.—M. J. R. DUNSTAN in *Farmer and Stockbreeder Year Book*.

Agricultural Tractors.—During the past year, the farm motor has continued to show its utility upon an increased scale. It has helped very materially in the solution of the problem of making the British Isles independent of sea-borne food supplies. It has been so widely employed as to have become familiar to every farmer. It has gained compulsorily in the course of a year or two more attention than would have been given to it voluntarily and under more normal conditions in perhaps ten years. Until recently, very little inducement was offered to engineers to turn their attention seriously to the development of agricultural motors. Some few pioneers continued their persistent endeavours to popularise these machines, but only with a very limited degree of success. They found themselves faced by a staunch conservatism, and their difficulties were increased by the qualified success of a fair proportion of the machines put into service, and by the fact that, perfection being unobtainable in the early stages, the user, as well as the designer, must in the initial period either be buoyed up by faith and optimism, or else his circumstances must be such as to render the use of new machines a necessity. Just lately the demand for agricultural motors has suddenly become so great that the first attention of manufacturers had to be devoted to increasing output rather than to the development of improved types. Nevertheless, considerable advance has been made, but despite this fact, we have not yet reached finality or perfection, and certain more or less preliminary problems still remain to be solved.

At present there is no unanimity of opinion as to the relation which the power of a tractor ought to bear to the weight. The view of the majority is favourable to a light machine of considerable

power. Thus, the Committee of the Scottish Trials in 1917 came to the general conclusion that the weight of a tractor should not exceed 30 cwt., while the power should not be less than 20 b.h.p. Certain tractors answering to this description have unquestionably been giving extremely good service under a wide variety of conditions upon both light and heavy land. At the same time there still remains a strong volume of opinion favouring heavier and more substantial construction partly on the grounds that greater length of life is thus rendered possible, and partly because it is maintained that there are circumstances under which a light tractor is intrinsically unable to utilise much power because its adhesion is limited by its weight.

On the more general question of whether the agricultural motor should take the form of a tractor or should be combined with the implement to form one single unit, we have more nearly arrived at a decision. It seems clear that the greater part of the demand will be for separate tractors, because of the variety of the services to which these can be applied, and the ease with which they can be diverted from one type of service to another. At the same time, it is equally apparent that there is and always will be a definite field for the self-contained motor plough, particularly if built of moderate dimensions, so as to be applicable for use in comparatively narrow spaces between growing crops, as, for instance, in market gardens and in orchards. It is probable that no self-contained machine to plough more than three furrows of average depth and width will be required in numbers. In the majority of instances, two furrows will be sufficient, and the engine power need not be more than ten or twelve h.p.

These self-contained machines invariably run with one wheel or track in the furrow, and, this being so, they must be so designed as to make it possible for them to be kept upon an even keel, despite the fact that one wheel or track is at a lower level than the other. This problem has been adequately solved in such machines as the Wyles, the Fowler, and the Martin. Another point about these little self-contained implements is that their weight is so moderate that even when carried upon wheels there is little to fear in the way of any ill effects upon the soil either just below ground level or at the base of the furrow.

As to whether the ordinary tractor should run with any of its wheels in the furrow opinion remains divided, but on the whole it is perhaps favourable to doing so. A disadvantage is that the average tractor in this position is heeling over towards one side, which imposes side stresses on the wheels, axles, and other parts. In

certain instances, including the self-contained ploughs already mentioned, and the Whiting-Bull tractor, this difficulty is overcome by special design.

Another possible objection is that the soil at the base of the furrow may be consolidated or panned, interfering with free drainage. Moreover, the width of the furrow limits the width of the driving wheel of the tractor running therein, and prevents extremely wide wheels being used for the purpose of distributing the weight over a bigger area. On the other hand, running with one wheel in the furrow generally permits of a more direct pull between the tractor and the ploughing implements. When running on the edge of the land the obliquity of the pull tends to drag the tractor round, increasing the difficulty of steering and possibly breaking down the edge of the furrow. Moreover, it is frequently argued that, provided spuds or strakes are fitted to the driving wheel, the effect of running in the furrow is similar to that of deliberately working the sub-soil to improve drainage.

Considering for the moment only wheeled tractors, there is still diversity of opinion as to the number and arrangement of wheels desirable. When all considerations are taken into account, it will probably be found that the four-wheeled machine will continue to be most popular. The front wheels may be set nearer together than the driving wheels without necessarily rendering steering difficult. A single steering wheel, carrying little weight, tends to make the tractor rather unmanageable on sharp turns. Two driving wheels will almost certainly be preferred to one, however large and wide, but it is well that there should be some means of locking the differential gear, so that the power may be effectively applied when one of the two wheels is badly placed and tends to spin round.

It is impossible to say as yet to what degree wheeled tractors will be displaced by machines fitted with one or other of the forms of chain track of which the caterpillar drive is typical. The chain track undoubtedly allows the weight of the tractor to be distributed over a very large area, so as entirely to solve any difficulties connected with compression of soil due to high intensity of pressure beneath driving wheels. A chain track machine is capable of working satisfactorily over extremely uneven ground, a fact which is well illustrated by the success of the tanks. On the other hand, the chain track introduces complications and losses of power in transmission. It is argued against it that, in any practical form, it involves comparatively high cost of up-keep. In some forms it is distinctly liable to injury by stones or other hard obstacles being

caught up between the elements of the track. Up to the present there is certainly no distinct sign of the chain track machines developing in popularity sufficiently to jeopardise the future of the wheeled tractor.

Turning to the question of engines, there is still a wide range of opinion as to the type most desirable. Some makers favour a four-cylinder engine on the lines of that of a motor car. Others prefer one or two horizontal cylinders with a crank shaft rotating at a comparatively slow speed, more or less on the lines of a stationary gas engine. On the one hand, simplicity can be claimed; on the other comparative absence of vibration and a steadier pull. Whatever type of engine is used, it is now very generally agreed that a governor should be fitted; otherwise there is considerable chance of the engine being run at too high a speed, with excessive vibration and rapid wear.

Paraffin appears to be the fuel of the near future for farm tractors. Unless petrol becomes very much cheaper, its price is all against it, and the heavier grades of petrol nowadays are by no means free from the disadvantages which accompany the use of paraffin. The main point is that all these heavier fuels tend to permit certain of their constituents to run down the cylinder walls and mix with the lubricating oil, which is thereby rendered ineffective. The trouble may be more or less minimised by special vaporisers and by well-fitting pistons, but it cannot be prevented altogether. Provision should be made for replacing the lubricating oil fairly frequently, running the old oil out before doing so. Various special carburettors may be employed in connection with paraffin and other heavy fuels, and there are also devices for heating the heavier fractions of such fuels before they reach the engine, in which case they are less likely to cause trouble. At present, however, we have not reached perfection in the matter of the means available for using cheap fuels without any bad results following.

On wheeled tractors it is, of course, necessary to provide devices to help the wheels to get a good grip on soft land. These may take the form of spuds, spikes, or bars, the latter reaching right across the rim of the wheel. On the whole, experience favours the use of a sufficient number of fairly short spuds, not very wide, set diagonally. Another point in this connection is to design the fittings, whatever they may be, so that the job of putting them on or taking them off only takes a very few minutes.

Various schemes for getting over the difficulty of adhesion on soft or greasy land involve the principle of employing implements actually driven by the engine, instead of a plough of the ordinary

type. If this is done, the implements, while being forced into the land, help to propel the tractor forward. Usually a machine on this principle is a cultivator rather than a plough, and the implements are numerous and rotate round a central axle, some spring device being provided to prevent breakages when obstructions are encountered. These special machines have not made much progress during the last year or so, possibly because the problem of the moment is to make the best possible use of existing implements, and anything that involves the manufacture of fresh implements of an entirely new type is handicapped. Moreover, the substitution of a process quite different from ordinary ploughing is in the nature of an experiment, and is one which few people care to make under present circumstances.

Finally, we have the question of whether the tractor of the future will be specifically intended for ordinary work upon hard roads as well as upon the land. In countries where the roads in agricultural districts are mere dirt tracks, the problem does not arise. In Great Britain, it is neither legal nor expedient to use for haulage along the road machines the mechanism of which is not well protected from vibration by efficient springs. Adhesion on roads cannot be achieved by fitting spikes, or spuds, or similar devices. A tractor for haulage on the road is, therefore, as a rule, a fairly substantial and heavy machine such as many farmers would not be inclined to use upon the land. If its engine is of the internal combustion type it must have gears providing not less than three speeds, whereas two speeds are generally sufficient for all kinds of field work. It may be found that, so far as Great Britain is concerned, the all-purpose tractor for road and land will, as a rule, be steam driven, while machines with internal combustion engines will be designed only for farming operations, and not for the haulage of produce. A certain amount depends on what the law may be in the future in respect of the use of mechanical transport on the road, and, until that is definitely settled, a final conclusion on this point cannot be reached. "ENGINEER" in *Mark Lane Express Almanac*.

Scientific Manuring.—Artificial or concentrated manures play such an important part in practically every farmer's work that he naturally regards them as one of the ordinary factors of the farm. It is wonderful how the word "scientific" has dropped out in respect to farming. Thirty years ago any thing off the beaten track was called theoretical farming; twenty years ago, and until comparatively recent years, scientific farming was used to distinguish that which involved the use of artificial manures from that in which

they were not employed ; now everybody is content to say simply farming. It means that many prejudices which then existed have gone by the board.

When a farmer hears a thing a little off the beaten track, he thinks it over, and tries to see if there is anything in it that will be of use to him. If he can learn a little more about some of the things he has had experience in he is glad of the opportunity. As a matter of fact, he has learned that because a few chemical terms are used it does not imply there is anything mystic or marvellous in them, but that they are very ordinary things. On the other side, those who had seen more of the laboratory than of the land have learned that the knowledge farmers possessed in connection with their business was quite as valuable, and in many cases as scientific, as that which they could offer ; or that, if not so scientific from the laboratory aspect, the farmer had got there first, and was doing what the laboratory confirmed. On his side " scientific farming," after all, is only enlightened farming ; the enlightened farmer is a far more scientific man than many think, and is always ready to become more so. It is time the term " scientific farming " dropped right out. The use of the word scientific was a great hindrance to farming. It is used now only by those who do not really understand what they are talking about. One does not talk about a scientific engineer.

When writing on the subject of artificial manures, it is, therefore, necessary to treat it very differently to what was done twenty years ago, when one had to persuade farmers to overcome existing prejudices. One cannot now assume that ignorance exists when the prejudice is removed, and practically all farmers are open-minded about them, and have had considerable experience in their use. Doubtless there are some points in respect to their use on which unnecessary stress is laid, and some of these, which emanated from good authorities as being useful to regard, have been considered by those who knew less about the subject as being imperative, and it has gone abroad that they are imperative.

A few years ago an idea prevailed that it was only in autumn that good could result from the application of basic slag. Many now know that very excellent results are obtained by spring dressings. The ordinary mineral manures, such as superphosphate, kainit, sulphate of potash, etc., are preferably sown on wheat land in autumn, though if they are put on after the turn of the year, so that they are well worked into the land in time for the spring growth, they are practically as effective. The difficulty is, especially in the wet winter and springs which have been so consistent in recent years, to get on the land to sow them when once the wheat is in ; but that must not be

taken as implying that if they are sown in winter or even later they will not be useful. On the other hand, they should be on by when growth is making in the spring. It has also been urged that these manures should be sown in autumn for oats and barleys, but, as these can be incorporated with the seed-bed, there is no special advantage in sowing them until spring.

The sowing of quickly acting nitrogenous manures is generally advised after the crop is up. In view of the frequency of springs when some weeks of drought come after the crops are up, and the manure does not dissolve and get down to the roots in time to be of full service to the crop, experience shows that they should be sown earlier, so that they will be in an active condition at the proper time. If they are worked a little deeply into the soil instead of lying close to the surface they induce the rootlets to work downwards into moisture, whereas if the plant food is on the surface the roots stop there, and if drought comes on suddenly and binds the surface, the crop suffers more than it otherwise would. Moreover, much food on the surface is helpful to surface rooting weeds, which thus get a start and master the crop, instead of the crop starting first and mastering the weeds. When weeds get this chance on a young crop in time of drought they take up moisture very quickly, so that the crop is bound to suffer. It is better to risk a little of the manure being washed out of the land by excessive wet in April and May than to wait to be caught in a drought. The chances of washing out are far rarer than of being caught in a drought; in fact, it is very exceptional that there is appreciable loss at that time of the year.

In respect to the nitrogen from air manures, some of which, at any rate, have strong caustic properties, my experience has certainly been in favour of sowing them well before the seed is sown. It is far better to let them have time for the caustic properties to be neutralised in the soil. In this way any injury that might result from the cauterising of the rootlets is avoided. Moreover, the burning of the leaf or flag which may result from applying them to the young crop is avoided. One good lesson that has been consistently taught is that all manures should be applied in a finely-divided condition and be evenly distributed. If this is not done the best results cannot be obtained.

It is not sufficiently recognised, by some who strongly urge the use of a particular manure, that by using it too frequently some other kind of plant food may be removed in excess. One often hears the remark that such and such a manure answers well the first time, but does little good on repetition. There are two reasons for this:—First, that there is enough of this manure still remaining in the

land ; or, secondly, that in producing bigger crops some other essential plant food has been too heavily drawn upon. This is often enough seen where nitrogenous manures are repeatedly used without other manures being applied at the same time. This is so well known that there is a common phrase, " It plays out the land." Nitrogenous manures, by doubling the crop, make a double demand on the phosphates and potash, and it depends upon how much of these there are in the land before the playing out is noticeable. If land were very rich in both it would be many years before it was brought to an unprofitable condition. It is only occasionally that both are so plentiful, and the giving out of either one means that there will be a breakdown in the cropping.

But the breakdown from the sole use of nitrogenous manures is rarely brought about as quickly as it is by the application of only one of the other manures ; in fact, if all the mineral manures that are needed to maintain a five-quarter crop of wheat be applied year by year, and no nitrogen be applied (wheat being taken every year), it will be found that on most soils the yield will not exceed that of an adjoining plot, which has received no manure whatever during that time. In like manner, a pasture may greatly benefit for a time by the help of a phosphatic manure. Should phosphoric acid be short, the grass will improve and the clovers will develop. But if the crop is taken off yearly it is quite possible for the potash to be overdrawn, and the application of further phosphates will be of little avail until potash has been returned to the soil. There is quite a lot of land which was phosphate short and with only a bare supply of potash, though sufficient for three or four crops, where the application of a second dressing of basic slag has not given a satisfactory result. It could not, because the taking away of the potash in the increased crops has brought the potash supply down below a working level. On other soils there may be a sufficiency of potash, in which case re-dressing with slag will give excellent results. Thus with corn, provided the grass crop were taken away every year, the increased quantity of crop takes away the nitrogen, and, to keep the balance, more nitrogen has to be returned.

There is no doubt that the more general use of superphosphate has had a good effect on the ordinary cropping of the farm. Without sufficient phosphates farmyard manure cannot work to full profit. On some of the most successfully farmed land in the country—that where potatoes are freely grown—superphosphate has been very liberally applied ; much more than is actually needed by the heaviest crop. This might seem like wasteful farming, but it is not, as it ensures a sufficiency of phosphates for subsequent crops, which

means profitable crops throughout. When large quantities of rich dung were used there was no special necessity to apply potash to moist soils, sufficient being in the dung. However, where artificials are more relied upon for the potato growing, the potash from dung naturally falls short, and those who indulge freely in potato growing with artificials will in course of time have to be more careful to maintain the potash supply. Crops grown with plenty of mineral manures are far more resistant to disease, particularly where nitrogenous manures are supplied very liberally, than are those which have not sufficient. Moreover, the tubers are likely to keep better in the clamps.

When sowing manures on the flat, as on pastures, there is a great temptation to use very wide distributors. As most of the distributors are of the long hopper type, there is considerable likelihood of too heavy loads being carried, with the result that in course of time the box sags, and the machine is strained out of shape and gear. There is no harm, and some advantage, in a long box, provided it is well stayed at all points, but too many makes depend on end supports. Users should be suspicious of these, though they have a remedy in their own hands by loading the hoppers very lightly. This, of course, entails more frequent refilling, but it is well warranted. The manure runs better and is better distributed, and the life of the machine is increased. A great difficulty in the making of manure distributors is to make them suitable for all kinds of manures, having varying weight and bulk, and in having to provide for such widely different quantities to be sown per acre. It would often pay those who use large quantities of manures to have a horse machine for the heavy dressings, and a hand-barrow for concentrated manures where from 1 cwt. to 2 cwt. are the limit of a dressing.

—W. J. MALDEN in *Agricultural Gazette*.

Rural Education.—The Board of Education in a Circular announce that they, jointly with the Board of Agriculture, consider the time has come when children should no longer be released by way of exemption from school attendance for employment in agricultural work. The Circulars permitting such exemptions are accordingly withdrawn, and the Board will now rely upon the local education authorities to resume the strict enforcement of the law of school attendance. The same Circular makes the important announcement that the appointed day for the purpose of section 8 (1) of the Education Act 1918—the section that makes attendance up to the age of 14 compulsory—will probably be fixed for the beginning of the term which follows the official termination of the war as declared

by Order in Council. This means that the Board contemplate that by September next at the latest all exemptions from school attendance under the age of 14 will cease. This is a matter that affects the whole country. At the moment it will be sufficient to consider the position in the rural districts. Apart altogether from the special war exemptions, the position as to school attendance in rural districts has been most unsatisfactory. The law in force at this moment is that in respect to children employed in agriculture a local authority may fix, by by-laws for any parish within its area, 13 years as the minimum age for exemption from school attendance, but in that case children over 11 and under 13 years who have passed the standard for partial exemption may become half-timers. This is the position under the Act of 1899, which was passed to allow children to be employed in agriculture at an earlier age than in other employments. Thus all education stops at 13, and full-time education at 11 if the parent so desires. The change which will operate from next September is very great. The Act of 1899 is repealed. There will be no more half time and no child will leave school until the completion of the term in which he or she attains the age of 14 years. The child who now becomes a half-timer at 11 years will thus gain more than three years' full education. If the time is used to the best advantage, the change should spell a revolution in rural education.

The old system was defended on two grounds : first, the need of labour ; and, secondly, the starvation wages paid to the agricultural labourer. It was the old vicious circle, and it was always the child who had to pay the penalty of unsound economics. The system paid no one. No doubt open-air work is healthier than factory work, and to a really intelligent child with some basis of general education there was open the chance to pick up a good deal of practical rule-of-thumb knowledge. But in fact there was and is no apprenticeship to any form of rural life in the system that is now to be swept away. The child performs purely mechanical unskilled duties, and receives no intelligent instruction save in very exceptional cases. There are, no doubt, a number of cases on small farms where young children are taught by their parents to milk and perform other duties in a satisfactory fashion ; but the agricultural labourer's child has no such opportunity. The need for technical teaching is perhaps more apparent in the case of rural children than elsewhere, and under the Act of last year it will be possible to build up on the elementary school course a really practical training in the main duties of the various branches of agriculture. It will be possible at the age of eleven to begin the "secondary education"

of the child whose life work is to be in agriculture. A course of three years, in which nature study and outdoor work take from the first a definite part, is not inconsistent with a sound general education. The course would dovetail into the compulsory part day-time continuation courses which would follow when the child reaches the age of fourteen. There will be central courses, and the central village school connected with outlying villages by motor vehicles will have its field, its garden, its greenhouses, its out-houses, and workshops. A sound agricultural training in which theory and practice would be aptly mingled will be provided, and the training will find its natural fountain of policy in the agricultural college of the area. In this way it will be possible to secure a really trained agricultural population.

Yet there is one danger that has to be guarded against. We understand that certain local authorities are proposing to send the young persons in rural districts who are required to attend continuation schools to those in the great towns of the area. This plan may be convenient and may seem financially cheap, but it would prove a grave mistake in practice. The true policy is to send town children out to the rural continuation schools, and thus create a movement back to the renewed life of country districts.—*The Times Educational Supplement*.

Egg Production on the Farm.—Of the two chief branches of utility poultry keeping on commercial lines, *i.e.*, egg production and the rearing and fattening of table fowls, the former finds most favour on the great majority of farms, and the reasons for this preference are not far to seek. Not only are eggs in universal demand, and therefore easily disposed of locally, but the care of laying stock kept under ordinary farm conditions entails a smaller expenditure of time and labour than is involved in the conduct of rearing or fattening operations upon any considerable scale, whilst the demand for table poultry is more restricted. Hence any extended production of the latter has tended to become centred in certain areas where various favourable circumstances have contributed to make it more than ordinarily profitable, whilst the keeping of laying fowls is general in many localities.

It is, perhaps, less commonly realised than it should be, that farmers are far and away the biggest egg producers, and that it is to the farms our markets look for the great bulk of their supplies, despite the fact that the majority of agriculturists give little thought to what is a relatively minor branch of their scheme of production. While certain improvements in methods of management have been introduced during the past decade, on the other hand, some of the

factors that would tend to encourage a greater consideration for feathered stock have been lacking, and in some districts the possibilities of making a reasonable profit have been much more limited than in others.

Notwithstanding the predominance, in point of numbers, of farm-produced eggs, over those produced by the comparatively few specialists, it is a notable and regrettable fact that the quality and freshness have usually fallen far below the requirements, with a consequent loss of profit and reputation. That this is not entirely the fault of producers becomes evident upon an impartial examination of the marketing facilities that commonly prevail. It may be said that the secret of success in the marketing of such produce is to be found in co-operation, and to some extent this is correct, but it does not solve the problem with equal success in all circumstances and localities. Conditions are so varied and facilities so unequal—more especially as regards transport—that many home producers must remain at a disadvantage until a more widespread system of rapid transit has been evolved and put in practice.

Eggs are among the most perishable of produce, so far as their first freshness is concerned, and this quality so materially affects their value (and consequently the margin of profit) that the surest way to induce farmers to consider more seriously the advisability of producing more eggs and marketing them in better condition would be to provide better facilities for carrying the produce to the centres of consumption without avoidable delay or undue addition to the costs of production. That there is a reasonable prospect of improvement in this respect, by the introduction in the not too distant future of a general system of rapid, cheap, and frequent transport facilities for the marketing of the various kinds of perishable produce, makes the situation much more hopeful than it has appeared hitherto, and should serve to encourage the required development of egg production upon the lines best suited to farm conditions.

It would be as ill-advised as it is, indeed, practically impossible, to lay down hard and fast rules in the matter of breed, or to suggest that this or that race of birds is generally suitable, although, of course, some breeds may be much more widely kept with profitable possibilities than others. Not only must soil, climate, and other local conditions be taken into account, but it has to be remembered that while some farmers prefer to confine their attention entirely to egg production, there are others with whom this primary consideration is tempered by the desire to have table fowls of fair quality available when required.

It would be too much to say that results obtained in laying competitions are in all respects equally suitable for the guidance of those who keep their fowls in the circumstances and amid the surroundings of the ordinary farm. Birds entered for these tests are largely the pick of flocks rigidly selected and bred from birds kept and reared under conditions that obtain on the generality of specialist "poultry farms." Nevertheless the results of laying tests aid the farmer in at least one important direction, by the indication of the productive capabilities of the several breeds and varieties.

There is ample evidence to justify the statement that farmers may find very suitable material in the White Leghorn, the Black Leghorn, the Ancona, the White Wyandotte, and the Light Sussex. The first three are, of course, of the so-called laying type, and are all related in respect of origin, and are obviously suited to the needs of those who seek eggs to the practical exclusion of other requirements, whilst the last two combine desirable table qualities with first-class egg-laying capabilities.

Leghorns, both White and Black, are capable of an excellent average egg yield, are very hardy, and on an open range materially reduce the cost of production by their active foraging habit. These characteristics are the possession of the Ancona, a breed that is very well worth the more general attention of farmers, being especially suited to the free conditions of an ample area on account of its extraordinary activity in search of natural food. Of the other two breeds, the White Wyandotte is well known as being capable of an exceptionally high average egg production, equalling and in some strains exceeding the yield of the more typical laying breeds, whilst for table purposes its qualities are quite good enough for ordinary requirements. In the latter respect the Light Sussex is to be preferred, the chickens being characteristically quick growers, and as an egg-producer this variety is excellent.

It should be noted, however, that in breeding for the development of laying qualities there must necessarily be some loss of table qualities, and that strains bred and selected for egg production or even a dual purpose, are less suitable for table chicken production than strains bred for this only.

Farmers who seek to develop egg production as the chief object of their poultry-keeping will find it necessary to suit the housing accommodation to the particular requirements of the birds kept for this purpose. It will be evident, upon reflection, that haphazard methods of housing poultry are not conducive to profitable success, whatever the aim may be, and that suitable accommodation is as

necessary in the case of this as of any other kind of stock. In the provision of houses suited to the conditions that obtain during the open months of the year, there has been considerable improvement during recent years, and it is nowadays very usual to find handy and healthy types of field houses in use on farms. As a rule these have a portion of the front open, so that the interiors are sufficiently ventilated, and, being mounted on wheels, they are easily moved from one part of the farm to another, so that advantage is freely taken of the opportunity to run the birds on clean ground and to enable them to benefit by foraging over a wide area.

This is well enough during the months of fine weather, but such conditions are not calculated to maintain the egg yield at a suitably high level during the colder and wetter periods, and those who hope to make egg production reasonably remunerative must adopt methods likely to favour laying in winter—which so largely determines the profitableness of the enterprise. During the winter months the birds cannot forage far afield, and such foraging as may be possible is more or less fruitless, so that artificial methods must be adopted to encourage exercise, and hand-feeding must be on a more generous scale. A dry scratching floor is consequently essential, and this may be provided by the erection of permanent laying houses specially designed for the purpose, or by the conversion of an existing and otherwise disused farm building, such, for example, as a cart-shed or bullock lodge—both of these the writer has so used with considerable success.

Given facilities for marketing quickly and frequently, the farmer's part in the development of a much-desired increase in egg production consists primarily in the selection of stock suited to farm conditions, in housing them in winter in a manner calculated to keep up the yield, plus, of course, good feeding, and in attention to the essential details of good management generally.—J. W. HURST in *Mark Lane Express Almanac*.

Organization of Our Shows.—The history of Horse Shows and of Agricultural Shows would be an interesting study, if such a thing as a continuous history were possible.

Racing had long been familiar to the people before we find mention of a show, and it is in connection with racing that we find the earlier horse shows mentioned.

In the middle and latter end of the eighteenth century, when the pedigree breeds of cattle and sheep were beginning to take the attention of leading men in the country, agricultural societies began to be formed here and there, several of which, such as the Highland

and Agricultural, the Bath and West of England, and the Wharfedale, are still in existence, whilst many of whose existence no record remains doubtless did good work in their time.

It is only by an accident that the record of a curious show which was held at Thirsk in the latter part of the eighteenth century has been preserved. It was a sheep show and nothing more, but it was on such strange lines that it is worth a passing note. The classes were very different to the general run of sheep classes—for the best 20 shearling rams, the best 20 ewes, etc.—a species of classification which is still found, or was a very few years ago, at Boot in Cumberland. The way in which the classes were judged was unique. Every member of the society whose subscription was not in arrears was a judge and gave his vote.

The Horse Show and the Agricultural Show are essentially of English origin, and may be said to be the natural outcome of the improvement of which English farmers were the undoubted pioneers. As stock-breeding developed more or less on pedigree lines, the spirit of competition was roused and societies sprang up here and there, very different to those to which we have become accustomed, but societies which did an immense amount of good, held shows at which able breeders interchanged ideas and related experiences, thus enabling people to see what the pioneers of livestock breeding were aiming at, and how they were succeeding in achieving their object. It should be needless to point out that for a considerable time these shows were what we should now call local shows. In the early days of the nineteenth century it was impossible to get stock any distance. All would have to travel on the road. Sheep or pigs, perhaps, might be taken in carts, but cattle and horses would have to tramp it. It was not until railway days that it was possible for shows to tap a large area of country.

This fact wants steadily keeping in mind, for whilst the the railways undoubtedly increased the utility and service of shows, made them more representative, and stimulated enterprise, it must not be forgotten that in many instances the shows out grew the plans and regulations which still prevailed nominally, though they had become practically obsolete.

Then, undoubtedly, in some places shows were got up at which, at any rate so far as the originators were concerned, the improvement of stock was a very secondary matter indeed. At such shows the principle object of the promoters was popularity. They courted exhibitors persistently; their rules were laxly administered; and the most flagrant violation of them was allowed to go unpunished. The fact was that in many places the administration fell into more

or less incapable hands, and the result was chaos. That showing suffered from this laxity is undoubted, for the man who "played the game" was placed at a disadvantage, and consequently gave up showing. Every right-thinking person will agree that dishonourable, not to say dishonest, actions must be put down with a strong hand if showing is to take the place it ought to take in the nation's work of the future. Even if exhibiting were only a pastime—a mere game, we will say—the chicanery of late years would be scandalous. Much more serious is it, then, when showing becomes virtually a competition of national importance. There never was such an opportunity to put a stop to all show scandals as there is now. For three or four years the whole of our show system has been disorganized, and practically no shows have taken place. Even the "Royal" has been in abeyance for two years. What fitter occasion can there be to review the situation and to set forth resolutely on the road to that reform which alone can bring the show system as a system into a satisfactory condition?

An obvious remedy is a Central Governing Body, representative of the various leading societies of the country. We now have established a Federation of Shows for the counties of Lancashire and Cheshire, which has worked well for the interests of all concerned; but something more than that is wanted, in the shape of a National Association, which must govern as well as advise. That does not imply that its government should necessarily be arbitrary, or even severe. Showing being a national and not a local institution—even a local show is of national importance, as being part of the national scheme—it cannot be too strongly urged that it should not be regarded from a narrow view-point, and should not be governed under the influence of petty interests.

Luckily the position at the moment is perhaps the best possible for tackling this question. Our shows are, in a manner, calling for reconstruction; the evils which have existed in the past are seen; the necessity for reform is admitted by practical men; and we have an example before us which is working well, and with a description of which I shall finish this article. This is the Association of American Horse Shows Incorporated, which has already done so much good in the United States, and which seems set out on a career of prosperity. This Association of American Horse Shows consists of some eighty-odd societies which are, with relation to the Central Association, in the same position as an ordinary race committee, like that of York or Newcastle, with its self-appointed stewards, to the Jockey Club. The objects for which this Association was established, as given in the second article of the Con-

stitution, are as follows:—“(a) To encourage and promote horse shows; (b) to effect a better understanding among associations holding exhibitions of horses for prizes, and to enable them to work in co-operation; (c) to make and enforce uniform rules governing such exhibitions of horses; (d) to adjust difficulties which may arise between associations holding exhibitions of horses for prizes, and the exhibitors at such exhibitions.”

Surely the article covers all the ground necessary for such an Association. It does away with the anomaly of a man being warned off at one show and courted for his entries at another; and by giving an opportunity for a revision of sentences it prevents much injustice being done. We have known many a man warned off the Turf, restored after a period of time and become a very useful man, and what applies to racing applies equally to showing.

Not the least important of the conditions enumerated, perhaps the most important of them, is the one dealing with working in co-operation. It is more than likely that when things are settling down it may be necessary for the breeders of horses and of pedigree stock to speak pretty plainly to our legislators. And it is quite certain that the representatives of a thoroughly organized body such as the Association of Horse Shows will command more attention than the representatives of one or two or three of the leading shows.

The leading features of the constitution of the American Association present many features of sound administrative policy. It would perhaps be tedious to enter fully into detail here, but a few leading points may be touched upon. The members are appointed by a kind of double election. The society which desires to be represented elects a delegate for each ten dollars it pays to the funds, and these names come before the Board of Directors for confirmation, a four-fifths vote being necessary for election. Practically the amount contributed by Societies to the Association is 1 per cent. of their prize list; or, as the rule puts it, ten dollars for each thousand dollars or fraction thereof. So, by the means adopted, there seems every prospect of getting together a thoroughly representative body of experts—men who know the details of showing in all its branches—not only to ensure justice being done all round, but also to promote the well-being of shows, and guide their progress on right lines.

A few of the rules and definitions may be noted. First, then, about the entries, which must all be in writing and signed by the owner or his agent—a rule very much honoured in the breach at some shows I could name in this country. Horses cannot be entered in the name of any one but the owner except in cases of

leases, certified copies of which must be lodged. They are very particular about description : name, age, colour, sex, and pedigree are to be given ; and if a horse's name has been changed, the old name must be stated, as well as the new one, for six months. This is a rule which is only enforced at the Royal and a few others, and the consequence is that time after time we see one horse shown for another during the season.

The definitions are excellent and distinguished by fairness. A novice is a horse which has not won a first prize (at any Association show) in the particular division in which it is shown. In the case of novice pairs, *one* of the pair *must* be a novice.

An amateur is defined as one who rides or drives for the love of the sport, not as a professional or for a livelihood, who shall not receive any monetary consideration for his or her services, and shall not be professionally interested in the purchase, sale, or trading of horses.

Such are some of the leading features of the American Association of Horse Shows. They seem to me to be drafted with common sense and in the spirit of fair play. The societies which are incorporated have a perfectly free hand with their prize schedule ; and they have also the advantage of appealing to the central body when perhaps it would be difficult to deal with a question locally. The plan is an excellent one, and if it were adopted in England would surely have good results. Why not try it at once ?—WM. S. DIXON in *Live Stock Journal Almanac*.

The Village School.—Anybody who has lived in rural districts, particularly in the South and the South Midlands, knows how bitter has been the feeling of the better type of working man with regard to the village school. And this strong feeling has in most cases been fully justified. Moreover, as the columns of the *Supplement* have for the last two or three years indicated, the problem of rural education has been thought out, and there exists a body of ideas and propositions which, if acted upon, would produce a most beneficent revolution.

If new rural colonies come into existence as a result of the settlement of soldiers and others on the land, they must not be given the type of school, schooling, or schoolmaster which has hitherto prevailed. The spectacle of a village school in which the villagers take no interest, which stands apart from the stream of village life, which teaches things that have no sort of connexion with the practical affairs of the farm and garden and home, which ignores the fauna and flora and poetry of village surroundings, which exists merely

because of the law of the land—this must not be seen in any one of these new settlements, and must disappear from those places where it is still to be seen. If we are to “build Jerusalem in England’s green and pleasant land,” the superstructure must be raised upon the foundation of popular efficient education. What is to be done about education must not be an after-thought. We must start with the school; make it the very centre of the life of the community; make every adult share responsibility for what it becomes and what it does; let the boy who grows up and spends his life in the village be as much a part of it as when he was a scholar on the books. The education of the infant, the child, the adolescent, the adult, must all be provided for in it. In short, it must be the centre round which everything that partakes of the nature of education collects.

It looks as though the rural settlements would afford an opportunity for a fresh beginning in the matter of rural education. The plan appears to be to arrange a number of small holdings round a central farm. This farm will be a model; the men who work it will have it as part of their duty to give advice and information to the small holders; it will be the centre of their co-operative enterprises. Between it and the small holdings there will be very intimate relations. If the school could be associated with the farm, the fatal gap between the school and the outside world would disappear. Studies would be pursued as often outdoors as in. Arithmetical problems would be those of actual experience; the things the children did would be such as would interpret to them the world at their doors.

It is not necessary, however, to discuss what the schooling would be; it is quite sufficient to suggest that an opportunity will probably arise for making the radical change that most of us can see is necessary. Probably a good deal could be learned by a close study of the developments that have taken place in rural education in some parts of Canada and the United States. The mere theorist must be excluded when arrangements are being made.

The immediate question is as to whether the Ministries of Reconstruction, Agriculture, and Education are co-operating with a view to providing and utilizing the opportunity. As soon as ever it may be possible one colony should be provided, with a suitable man whose business it should be to develop a school of the sort required. Possibly a few men ought to be selected now and given a few months in which to see all the helpful things that can be seen in this country or elsewhere, so as to be ready to get to work when the time comes. The Board of Education urges necessity for experimental work in

education ; and if the promises of statesmen are fulfilled profitable experiments will be possible. That large numbers of soldiers are looking forward with eagerness to the opportunity of obtaining a home in the country and the chance of getting a living out of the land seems clear. It is not, however, only soldiers who are crying out for land ; there are many who have not been in the Army who will desire to be included in any scheme of settlement, and the opinion is general that every such wish should be satisfied. How happy would be this country if, whilst maintaining and even improving her position in the world of industry, she made as much of her countryside as the Danes in a single generation have made of theirs -- *The Times Educational Supplement*.

Agricultural Organizations. — The Agricultural Organizations (apart from Agricultural Societies holding shows, &c.) in order of seniority of age are as follows :—

The Farmers' Club, established nearly 70 years ago by well-known farmers, as a club and meeting place in London for agriculturists. Some six or seven papers are read in each year, and the discussions are useful and appreciated. Its policy is constructive.

The Central and Associated Chambers of Agriculture, founded some 54 years ago. It has subscribing members and over 100 affiliated local Chambers. General meetings are held monthly and there are numerous committees covering different subjects. Space does not admit a proper description of the value of the Central Chamber, and only a study of the big book, "Fifty Years of Agricultural Politics," by Sir Herbert Matthews, K.B.E., will give an idea of the marvellous work which has been accomplished. "There were giants in those days" may be applied to the Central Chamber. The giants are fewer now : perhaps the main battles have been fought and won during the first half of its existence.

The Central Land Association was started on the initiative of the late Earl of Onslow, and he was the first Chairman. Lord Bledisloe (then Mr. Charles Bathurst) was the first Honorary Secretary. These two made a marvellous combination of efficiency, and the Association did magnificent work. The underlying idea was to carry the voice of agriculture into the Houses of Parliament.

The National Farmers' Union was founded in 1908, and was previously called the Lincolnshire Farmers' Union.

There is a Federation of Agricultural Executive Committees, also a Federation of Women's Agricultural Executive Committees.

During 1918 a National Agricultural Council was formed. Some thirteen Agricultural, Labour, and Professional Associations and

Societies send delegates to its meetings, so that the united voice of Agriculture might be expressed. This Council has already been very active, and as in theory such a Council is ideal, we can only hope that it will win its way.

We have our great and small Agricultural Show Societies, which have done such marvellously good work in their particular line, and the Co-operative Trading Societies, that have been successful in districts wanting them. At the head of the latter is the Agricultural Organization Society, in the main supported by the State.

The number of Political Agricultural Organizations is sufficient, and no new ones are required. The National Agricultural Union was born, lived and died, and so did the Farmers' Alliance. The latter, however, was really wanted at the time, and that far-seeing man, the late Mr. James Howard saw that it was. Out of nineteen items on its programme, seventeen are, and for a long time have been, in being. It died of argument--Protection and Free Trade! But it accomplished what it set out to do, and therefore we may fairly say that it justified its existence. The National Agricultural Union never was really wanted. It was a temporary excrescence, and therefore short-lived; but its founder, Lord Winchelsea, most sincerely and honestly wanted things to be made better in the agricultural world, but instead of trying to gain his ends by the improvement of existing machinery, he tried to create a new machine. How often do we demand a new Act of Parliament, forgetting that there is an existing law which might easily be put in force?

The Societies above referred to represent Outside Organization. The members of these are free and unfettered to say and do just what they like. They are beholden to no one except themselves; they neither ask nor want State aid. They are members from voluntary choice, believing in the unbreakable faggot, while knowing that a single stick can be broken. By agreeing to pay an annual subscription, they believe in the necessity of their societies. They recognise that at any moment some question may arise calling for corporate action. They are content for their Society to do nothing when nothing is doing, but know well that it can be called together or mobilised at the slightest sign of attack. The newer theories of the more learned of the Modernists can be discussed, sifted, tried and used warily until practice proves their worth. The worthless ideas can be thrown on one side as being utterly unpractical, whilst they know that their society can usefully employ its members in "peace time" in educative matters from which they may or may not profit, and when necessary,

these can be suspended for the moment and the whole weight of the society brought to bear in the required direction.

This is what outside organization means. Long may it continue. It is necessary from a human and personal point of view—it is common sense in relation to profit and mere existence—it keeps us from getting more narrow than we are—it promotes brotherhood and good feeling, and in many cases creates new friendships leading to affection, which I suppose should be the governing factor in our lives.

Inside Organization is a creation of the War. By Inside, I mean having to do with Government or Departments of State. War demands special methods—we recognise this, and agree—we gladly submit to control in view of the common ideal of a successful ending of our national objective. Private interests, both in peace and war, have always to give way to national good. And national good and national necessity demand that when we are attacked in war we must win. Everything must be subordinated to that great objective.

To attain the required objective in true Agriculture (which really means Food, grown at a profit) we have had a host of Advisory and Executive Committees and a horde of officials. To the lasting credit of all—to the President of the Board of Agriculture, the Agricultural Executive Committees, the Advisory Committees, and the officials—results have been obtained which no country in the world has beaten. But (and I always listen hard when a man says “but” with an emphasis) is this control to remain in whole or in part, and what about the officials? To be quite honest with ourselves, we all love power. We strive to get power, and when we have got it, we take good care to keep it if we can. The keeping of power for power’s sake is a curse; it is selfish, and it thrusts on those who have not the power, that which is unnecessary and unwanted. The knowledge of the right moment to drop the power you possess over others is one of the most difficult problems of life. Many of those who are at present in power, and especially the rank and file, are inventing all sorts of inside organizations for use after the declaration of peace. They never seem to remember the outside organizations, although they are members. They are mad on Advisory Boards, Advisory Committees, Executive Committees, Delegates, etc. It sounds all very complete and beautiful, but to my mind, it is pure nonsense. What is our Political Constitution?

There is a Minister of Agriculture who is nominated by the Prime Minister of the moment and appointed by the King. He can be dismissed similarly, is a member of a Government and he must

stand or fall with his fellows. He must carry out the policy of his Government, or, if his conscience will not allow him to carry out a policy, he can always resign.

To my mind the President of the Board should be the Board, and there should be no sham Board without power. The onus must rest on the President, and he is entitled to either credit or blame, according to how he acts.

Now the question is whether Agriculture is to be governed in the next few years by what I call Inside Organization or by the Minister of Agriculture, helped and kept in the right paths by outside societies. Unhesitatingly I am in favour of the latter.

During the War I was a member of four Advisory Committees. On three out of the four we were simply useless tools of a Department. Our agendas were puerile and made up of stupid nothings, which would lead, and did in fact lead, to everlasting talk. We were never on one single occasion asked our views on any question of vital policy, and time after time we saw policies put forth by the Ministers concerned, and sometimes we were allowed to discuss them after they were a fact!

In the end, on one of the Advisory Committees (not Agriculture) I struck, and made a strong protest, giving a concrete example. Either, I said, we must be consulted or we should be sacked. The answer was most polite and conciliatory. The Minister agreed with every word I had said. It should not occur again. Our services were most useful and essential, etc., etc., and I felt quite pleased, but the Advisory Board was never summoned again! I am still a member, I suppose, and so are my colleagues. You see it looked as if we were going to be energetic nuisances instead of complacent fools, so we were shelved, and none of us complained.

In my view, after some experience, Advisory Committees are a snare and a delusion. The Minister should be responsible.

It is quite clear, I hope, that I am referring to Advisory Committees and to Ministries, and not to War Agricultural Executive Committees. Their functions are executive and statutory, and we all agree that they have done their work excellently, and bear high testimony to the carrying out of their unselfish and most onerous task.

I remember one more example of the futility of Advisory Councils or Committees. A long time ago—in August, 1914 I became a member of an Advisory Council to the Board of Agriculture, but it is so long ago that I have forgotten the name of it. It was a strong Committee with a splendid Chairman, Sir Ailwyn Fellowes. We met two or three days a week and really

worked hard. Early in September, 1914, we agreed on a long Report (which was printed) as to home food supply during the War. Our main recommendation was the formation of County Committees. It was by chance seen by some of the then officials of the Board of Agriculture before it was officially sent in. At the next meeting we were told that our idea was revolutionary, or words to that effect, and that it would be a great mistake to send the Report at all, for the Report would not be accepted, etc., etc. We were weak enough not to send it in, and all that time and opportunity were wasted. When in 1917 Lord Ernle became President of the Board of Agriculture, he at once instituted County Committees. This thought came from his own brain. It was not until long after that he knew of Sir Ailwyn Fellowes' Committee's previous but abortive invention.

If we wish for Ministerial Authority and no Inside Organization, then it follows that the Outside Organizations must be efficient, strong, representative, and command respect of Government Departments.

We are very far from that standard just now. It may startle some of you if, as a looker-on, I gave it as my opinion that not one of our Outside Agricultural Organizations either commands respect, or has any real weight in Government circles. The reason is that discussion is almost always confined to destructive criticism and hardly ever does any well considered and useful constructive matter emanate from any of them. It may have been necessary, but throughout the war if the resolutions are studied you will find that nearly all of them are on the question of money, either directly or indirectly. There is an adequate answer to this I know. I am only attempting to state a fact.

Another matter is that Agricultural Organizations do not take sufficient time or trouble to get the facts correctly stated before coming to a resolution. The whole machinery is hurried and spasmodic, and the result is often ill considered. My desire is to see Agricultural Organizations more efficient and possessing the same weight that undoubtedly they did possess years ago.

I venture to make three definite suggestions. (1) Copy County Council procedure and let all serious matters come before a Committee and let the General Meeting consider the Report. (2) Arrange for more frequent meetings of Committees and more frequent General Meetings, especially while Parliament is sitting, and more particularly when Bills are in Committee stage. (3) Spend more time and money in Agricultural Organization on the lines that if a thing is worth doing it is worth doing well.

The force of Agriculture expends itself at the doors of the Houses

of Parliament, just at the very point where its influence should be greatest. Mere resolutions of Organizations and Deputations have their uses and are essential, but only if they are followed up. The fact is (however distasteful it may be to hear it) that nothing is done in the political world without consistent and persistent wire pulling. Agriculture is too clean and too honest to do this, and so it gets left. Politicians are influenced into action by fear and also by "importunate widows." There is so much of this wire pulling going on that politicians can afford to neglect the legitimate needs of Agriculture. He who makes the most row gets the most done.

With regard to the power of Agriculture in the House of Commons. If we all took the trouble to get on to the Councils of the Political Parties in the Counties and Boroughs, and then to select, in suitable constituencies, new candidates who were keen on Agriculture, it would be a better plan than spending large sums on running Independent Farmers' candidates. At any rate it would cost nothing to try. If one could not get candidates who knew all about Agriculture, I would prefer a candidate who did not know anything at all about it, for there would be some chance of his wishing to do as he was advised by experts who did know something.

I have been speaking up to now of National Organizations, but what should we do locally in the counties? Putting it shortly, I would say "Join, Pay, and Work." Join every single organization which directly or indirectly is out to benefit Agriculture. A sovereign here and half a sovereign there would not amount to £5 per annum, which is probably less than we spend on tobacco and newspapers. Agricultural Show Societies will do their work if supported by all. The Agricultural Benevolent Institution should be helped by every farmer who makes a profit (so as to help those men and women who have fallen on evil days). County votes should be pooled.

There are many local questions of great importance to the farmers in the locality that cannot be dealt with by farmers individually, but only by a strong local organization. Amongst such questions we may mention the tolls charged at local markets, the granting of market tickets, and other facilities for attending markets, the carriage of milk, fruit, etc., by convenient trains and at fair charges. Again, the legal aid which can be given by a strong Union to its members is often of inestimable value. It is often impossible for an individual farmer, however good a case he may have, to go to law with a railway company or other strong corporation, but if the individual farmer is backed up by a strong Union a very different complexion is put upon the matter, for even the strongest company

will hesitate if it knows that instead of a single farmer it will have against it a union comprising many thousands of farmers. Many cases have been satisfactorily settled without ever coming into Court, others fought and won which, if there had been no Union, would probably never have been fought at all.

Looking at the matter quite broadly and from a national and political point of view, if there were no other Agricultural Organization except the National Farmers' Union you would find in time an equally strong Landlords' Union to which farmers were not eligible for membership, and a strong Labourers' Union. Each would recruit as big an army of their particular followers as they could, and the three armed forces at times would glare at each other, and on occasions, engage in battle. Each one for itself—is not an ideal to be cherished. The Landlords' Army would certainly command the most cash, and what may be called influence; the Labourers would be first in political might; and the Farmers' army, as has happened in the past, would be crushed between the two mill-stones.

No, there must be other organizations in Agriculture, because from a State point of view there are other interests than those of the farmer. There are the Land question, the Food question, rural population, Health questions, the future of the race, Imperial and Local Necessities, Wages to Labourers, and generally, the relation of subject to subject, and subject to State all to be considered. We cannot live alone in watertight compartments apart from the community of which we are members.

Chambers of Agriculture and Farmers' Clubs afford an opportunity for landlords, farmers, and all others interested either directly or indirectly with Agriculture, including members of the House of Lords and the House of Commons, to meet. By rubbing shoulders with others we can often influence them, and learn something from them. After all, we are not all in Parliament, and surely it is common sense for our legislators to join as often as possible in our debates and conferences, and thus be cognizant of our doubts and difficulties. If we live apart from them, how shall they know us?

I would suggest as an emblem for Agriculture a representation of an eight-oared boat taking part in a race. The oarsmen are all pulling together; they have a common objective. They are out to win, and they know that this can only be achieved by all pulling together. Let Agriculturists follow this example.—SIR H. TRISTRAM EVE in a paper read before *The Bedfordshire Chamber of Agriculture*.

The Weather.—"Well, Bill, what do you think the weather's going to be?" This is a question the young sailing man generally puts to the old salt, and he vaguely wonders why the old fellow is so often able to give him some pretty trustworthy information. Bill, however, gets up early in the morning, has a look at the glass, has seen the sun rise, and so by 9.30 a.m. the summer's day is for him well advanced. All his life he has watched the days grow in just the same way, and the observation of the weather has become a second nature to him.

"Clouds coming up, Bill; I hope it's not going to rain." "No, sir, no," says Bill. "Fine day, fine weather, I reckon," and so our young sailing friend goes on his way contented.

Well may he do so, for there is no better judge of the weather on our coast than the keen and experienced fisherman.

It is obviously desirable that every farmer should endeavour to know something about the weather. He should keep an eye on the "glass" and see what it is doing. A correct opinion of what the weather is going to be like cannot, strictly speaking, be formed from observation of the glass alone, but the variation of the barometer must be considered in conjunction with the temperature and moisture of the air, the present direction and strength of the wind, and the appearance of the sky.

When the barometer is steady, and continues so for any length of time, settled weather may be expected. When it is unsteady we look out for a change or possibly a gale.

In an ordinary gale of wind the strongest breeze often occurs at the beginning of a rise of glass, after it has been at its lowest. A sudden rise of glass is almost as bad a sign as a sudden fall.

In the Northern Hemisphere, the wind generally goes round with the sun. It shifts with the sun. This is called *veering*. An easterly wind thus veers with the sun S.E., to S., and S.W. A Westerly wind veers or shifts to E. through N.W., N., and N.E. This *veering* of the wind occurs in fine weather. Now, in bad or unsettled weather the wind goes the other way, against the sun; this is called *backing*. When the wind backs right round, or steadily backs, it is a bad sign. In fine weather, however, a S.W. wind will back to S. and veer again to S.W. without indicating any change of weather.

When the wind shifts against the sun
Trust it not, for back it will run.

There are several of these old couplets worth remembering.

These sayings are sound, as they are backed by scientific reasons. A rainbow in the morning indicates the advancing raincloud from

the west when the sky is clear in the east, and the late Admiral Sir Frederick Bedford has pointed out that the fall of rain at that time of day when the temperature should be rising, is prognostic of a change to wet and stormy weather. "On the contrary," the Admiral has said, "the conditions under which a rainbow can appear in the evening are: the passing of the raincloud to the east, and a clearing up in the west at a time of day when the temperature has begun to fall, thus indicating a change from wet to dry weather." Thus we have:

The evening grey and the morning red,
Put on your hat, or you'll wet your head.

This couplet refers to the red clouds on the horizon in the morning lowering as the morning gets on, which is a sure sign of bad weather. A rose tint high up in the sky at dawn may be seen in, and is the sign of fine weather.

The late Admiral Sir Frederick Bedford prepared a number of most useful notes upon the foretelling of the weather from the colour of the sky and from the appearance of the clouds. Ordinary English weather may be foretold with considerable accuracy by watching the colour of the sky and the formation of the clouds in conjunction with observation of the barometer. Such notes are, of course, invaluable. The state of the barometer should be entered in a book, and the state of the weather and direction of the wind. A note should also be made of the state and nature of the clouds.

Sir Frederick Bedford's notes run on these lines:

At sunset: Whether clear or cloudy, a rosy sky presages fine weather; a sickly, greenish hue, wind and rain; tawny, or coppery clouds, wind; a dark or an Indian red, rain.

In the morning: A red sky, bad weather, or much wind, perhaps also rain; a grey sky, fine weather; a high dawn, wind; a low dawn, fair weather.

Soft looking or delicate clouds foretell fine weather with moderate or light breezes, whilst hard-edged, oily-looking clouds foretell wind. A dark, gloomy blue sky is windy, but a light, bright blue sky indicates fine weather. Generally, Sir Frederick said, the softer the clouds look the less wind, but perhaps more rain, may be expected; and the harder, the more greasy, rolled, tufted, or ragged, the stronger the coming wind will prove. A bright yellow sky at sunset presages wind. A pale yellow at sunset wet, an orange or copper, wind and rain.

When high upper clouds cross the sun, moon, or stars, in a direction different from that of the lower clouds, or in a different direction

from the wind felt below, a change of wind to the direction of that of the upper clouds is foretold. Thus, if there is a certain wind, and the high clouds are travelling in another direction, one may expect before long the wind to come in the same direction in which those clouds are travelling.

The misty-looking clouds which hang like fog over heights and headlands only foretell wind and rain coming if they increase or lower. If they show a tendency to rise or disperse the weather will improve.

The light scud clouds so often seen flying low in the Channel indicate wind proportionate to their speed. They only indicate rain when passing beneath heavier, darker masses of cloud above them.

Very often, when the glass is high and steady, you can see these scud clouds flying low, but the sky above is clear, or the upper clouds look light and high, then—especially if the scud is inclined to break, as in summer—the weather will improve.

The principal names of the clouds are the Cirrus or mare's tails, the Cumulus, the Stratus, the Cirro-Cumulus or mackerel-sky, and the Nimbus or rain cloud. When the mare's tails (streaky whisks and fibres of cloud) run across the sky in the direction of a light wind, this means it will soon blow harder or hard from that direction and remain steady. If the mare's tails are fluffed up at the ends and blown back as if by a change of wind at a high altitude, the wind below will ultimately veer round as indicated.

Cumulus is a dense cloud, in rounded form, clearly defined above and horizontal below, and is often seen on a summer's day like lumps of cotton wool. Coming and going in the heat of the day it indicates a continuance of fair weather. Seen all day and increasing and lowering towards night, it means rain.

Stratus is a continuous sheet of cloud (it is sometimes called the night cloud). It is the lowest sort of cloud, increasing from below upwards. It often forms at sunset, grows denser during the night, and disappears at sunrise.

The mackerel sky, little rounded white clouds definitely separated, in parallel rows, by blue sky, comes in warm, dry weather.

A combination of the mare's tails and the night cloud is called Cirro-Stratus. It foretells a storm, and according to its density the nearness of the storm may be judged. When this cirro-stratus spreads out, and cumulus clouds at their lower altitude beneath drift in from windward, the Nimbus, or rain cloud, is formed, from which continuous mass of cloud comes a more or less prolonged spell of rainy weather.

The farmer should endeavour to become a careful observer of the weather, and, in the course of time, his training will teach him to foretell it, as well as any fisherman, or at least well enough to be of great service to him. He will know by instinct the light, delicate tints and colours in the sky and the soft, indefinite forms of clouds which accompany fine weather, and he will be able to judge, by the gaudy and unusual hues in the heavens, and the hard, definitely outlined clouds, when to have his oilskins ready for rain.—In *The Field*.

The Farmer's Library.

NOTES AND REVIEWS OF NEW BOOKS.

1.—*Manual of Milk Products.* By WM. A. STOCKING. London : Macmillan & Co.

Of the many books which have been published of late dealing with Milk and Milk products few, if any, are so complete as this. The author, who is Professor of Dairy Industry at Cornell University, owns that it is made up largely of quotations, and has been prepared for the purpose of bringing together the work of the best authors into such a form as to meet the needs of busy persons, both students and men engaged in commercial work.

Hence it is intended to serve as a reference book. By this standard then it must be judged, and our first demand in a book of reference is for a very complete Index. But here it fails. Many subjects dealt with in the text are not mentioned in the Index. True, the book contains a very detailed "Contents" in which could be found the subjects that were lacking from the Index.

It is well to start by drawing attention to a fault when one feels that the remainder of the notice will only be concerned with pointing out the good qualities of the Manual. Like several books which have been dealt with in previous volumes of the "Journal," this is one of the Rural Manuals published in America for American readers, and is founded mainly upon American experience. It is a pity that we have no similar work published in this country and based on our own experience and investigations. In some respects the two books would naturally not agree, and this would open up the problem of why they differed. It is well that readers in this country should, while gathering information from this work, compare it with their own experience or what they have been taught, and not assume that facts true for the conditions under which they were obtained in the United States must necessarily apply equally under the conditions prevailing in this country.

Milk secretion, that marvellous function of the mammary gland, about which opinions so widely differ, is the subject dealt with in the

first chapter. We have never known how or whence arose the erroneous view held so largely in this country that the smaller percentage of fat, found in the morning's as compared with the evening's milk, is due to the animal absorbing the fat after it has been secreted. The author wisely does not mention this. He enunciates views which are far more rational and scientific, and more generally accepted by the thinking world.

Having dealt fairly fully with the composition of milk—one might more justly say with the varied composition of milk, for probably there is no natural product which varies so greatly—the factors which affect the composition, and so give rise to these variations, are discussed. This subject is not only of scientific value but also of great practical importance. Unless these factors are known to the milk producer great losses may be incurred which, by care, might be prevented or at least diminished. But their importance does not end here. We are convinced that many honest men have been convicted of fraud, of having adulterated milk wilfully, simply because the milk, owing to one or more of these factors, has fallen below a certain limit of composition. It would be well if Magistrates who have to hear milk cases would carefully study this most important subject of the factors which affect the composition of milk. While this manual would give them much information it does not completely cover the subject, and in some respects English experience does not accord entirely with the views selected for quotation by the author.

The two following chapters are of educational and special interest to the few rather than the many because they deal with the physical properties of milk and the methods of testing milk and cream.

The subjects which next engage attention have, however, a very special interest to all at the present day. The production of milk for direct consumption or what the author terms **Market Milk** is one which affects both producer and consumer. The main problem which concerns both is how to produce clean milk. In an attempt to solve this problem America has probably gone further than any other country, and what has there been done is fully described and illustrated. The ultimate result has been in certain cases to produce milk under the supervision of a Medical Milk Commission and such milk is known as "Certified Milk." However desirable such milk may be there are certain obstacles to its profitable production and we are pleased to see that the author does not shirk stating these.

We next pass to a full description first of Butter-making and then of Cheese-making, both being treated more from the factory than from the home makers' point of view. At the end of the chapter on Cheddar Cheese, the eighteen chief defects to which

such cheese is liable are tabulated in an admirable manner, such as we have not seen in any other manual. As an example we will reproduce that on:—

“J. Gassy Cheese.” “Indicated by the presence of pin holes. They usually have a bad flavour, are spongy, and the curd may float on the whey in the early stage of manufacture.

CAUSE.

- (1) Gassy milk produced by bacteria which are carried in by dirt.
- (2) Gassy starters.

HOW TO PREVENT.

- (1) Gassy milk should not be accepted from any patron.
- (2) Gassy starters should not be used.

REMEDY.

- (1) If it is known that the milk is gassy, use a safe amount of clean commercial starter.
- (2) Ripen the milk a trifle more before adding the rennet.
- (3) After cutting, stir the curd till the whey around it shows at least .15 per cent. acid before heating.
- (4) Heat slowly. Take from thirty minutes to one hour.
- (5) Care should be taken to not have the curd too firm in the whey before the acid starts. An acidimeter is a valuable guide at this time.
- (6) A little more acid should be allowed to develop before removing the whey. About .32 per cent. after the whey is all off is sufficient.
- (7) Should the curd float, remove enough whey to bring the curd to the bottom of the vat.
- (8) Pile gassy curds before and after milling.
- (9) After milling, the curd should be thoroughly stirred and aired before piling. The pressure causes the small pieces to become very thin. After the piling and airing have been repeated a few times at intervals of fifteen to twenty minutes, the gases should have nearly all escaped. The pin holes will then have become flattened and present a “dead” appearance.
- (10) The whey running from the curd at this time should show 1.2 per cent. acid.
- (11) Cool curd well before hooping.
- (12) Press for two days if possible.
- (13) Ripen in a cool place.”

As is only natural, most attention is given to Cheddar Cheese which in America, as with us, is the Cheese of greatest importance. But under the head of Fancy Cheeses many, if not all, of the other cheeses made in America are described, including some of the Dutch and Swiss types which are there in demand. This chapter also is mainly concerned with those cheeses which can be produced on factory lines.

Subsequently the whole question of Farm Dairying, both as regards Butter-making and Cheese-making is entered into separately. The remainder of this exhaustive manual is devoted to other products of milk, *e.g.*, condensed milk, milk powder, or dried milk—called by the author “powdered milk”—fermented milk and ice cream making.

Finally there is a short chapter on “the relation of Bacteria to Dairy Products.”

If the author has sunk his individuality to a large extent by quoting mainly from the best work of others, he has none the less shown his grasp of the subject by knowing what to quote and how to quote it, and his work will take high rank as a manual for those interested in milk products in this country.

2.—*The Farm Tractor Handbook.* By GEO. SHERWOOD. London :
Iliffe & Sons, Ltd. 5s.

There can be little doubt that the Tractor has come to stay ; that its use will increase, and that a demand will arise for those workers who can use it to the greatest advantage. To use any machine aright requires knowledge and skill, and, while the latter can only be obtained by practice, the former may to a large extent be obtained from the study of special books such as the handbook in question.

In the pages of the *Agricultural Gazette* there have been described about two dozen different tractors. The first difficulty of a farmer who desired to purchase one would be to decide which of the many now on the market would best suit his purpose.

The author first sets himself to aid the farmer in his choice of a machine that will meet his particular requirements. Subsequently he explains in simple language “the manner of its working, how to maintain it in good order, and how to use it to the best advantage.”

The book commences with a well-illustrated description of the various parts of which a tractor is built up. Anyone who has attempted to describe a machine or any part of a machine to one

not having previous knowledge, knows how extremely difficult the task is. We were rather sceptical as to whether the author would succeed in this primary yet essential task, and we have been more than satisfied with the admirable way in which he has overcome this initial difficulty. Some of the descriptions will need reading several times before they can be clearly grasped. This, however, is unavoidable, and any reader who thinks that it is the fault of the author would do well to sit down and try himself to write out a description, equally accurate and yet more easily grasped by a novice.

Having described the various parts, some different types of tractor are considered. This chapter might with advantage have been made far larger and more detailed, and then many of the illustrations which are interspersed in the earlier chapters and are there somewhat out of place might well have accompanied the descriptive letterpress. Then the owner of a particular tractor could study the special details of his machine.

Chapters on Ploughs and Ploughing, and descriptions of other implements with which the tractor can be used follow, and the remainder of this very useful book is devoted to Steam Tractors.

The numerous owners and users of tractors will certainly welcome this handbook. We hope that when another edition is called for an attempt will be made to produce a more complete and detailed manual. Considering the great cost of a tractor, the loss entailed by not keeping it in order, and the difficulty which will be found in some localities to get repairs done, a thoroughly detailed, complete and scientific manual should be developed out of this handbook. One great fault of our English manuals, in the past, has been the absence of detail.

The reason why foreign books take such a high place in this country is due mainly to their containing this detailed information. Americans have already realised this, and have determined to equal European bookmakers in this respect, and unless British authors and publishers set themselves to overcome this want of thoroughness we shall find our students again seeking in books produced abroad for those essential details the importance of which we have hitherto failed to realise.

The greater the knowledge of a machine possessed by its user the longer will the machine last, the better will be the work that it performs, and the greater the ease of working.

As the Tractor is new to this country and those who use it are often new to such work, any book which will provide information such as this one does cannot fail to be of great utility.

3.—*Western Live-stock Management.* By **ERMINE L. POTTER.**
London: Macmillan & Co.

If the books to which we draw attention were intended for dwellers in Great Britain only, there would be no need to mention this volume. But we know that many of our readers are more or less indirectly interested in the Agriculture of our Colonies, that in both Australia and South Africa there are districts not unlike the Western area of the United States, and that many of the soldiers when they return from doing their duty to the Empire will probably turn their attention to Agriculture. In fact, we have heard it stated that in Australia there is some thought of giving ex-service men an opportunity to acquire land in the districts where such is available. Many of these lands are in districts somewhat similar, as regards climate, to the country whose farming is described in this book. In fact, some of the illustrations relating to sheep are taken from Australia.

It is because the authors—for Prof. Potter has had the assistance of three experts, one a specialist in Horses, another in Sheep, and the third in Swine—have described conditions “as they actually exist” that we consider the work worthy of attention by others besides those who live within the area with which it deals.

The subject matter is divided into five parts. The first deals with the West—“fascinating, full of inspiration and attainment.”

In order that readers may get an idea of the nature of this country, if only to compare it with that in which they are interested, the following facts may be of interest. The greater portion of the area has an elevation of from 4,000 to 10,000 feet above sea level, only a comparatively small part being from 2,000—4,000 feet. The most noticeable feature is the limited rainfall, which is less than 20 inches over almost the entire region, while some parts have even less than 10 inches. This dry climate, combined with the high altitude, tends to make the summers rather cool, particularly at night, although it may be quite warm in the sun during the day.

In such a climate, and under the conditions which there exist—what we now term “environment”—a definite system of agriculture has grown up. It has become essentially a live stock country, and, in the opinion of the author, “must remain such because of the fact that we have an immense quantity of feed in the form of grass and hay which cannot be used directly for the support of the human race, and therefore must be converted into live-stock before it can serve any useful purpose.”

Before entering into details regarding the management of Live-stock, which is the main object of this book, some general principles

of live-stock production are set forth. The chapter contains much valuable advice, some of which might with advantage be taken to heart in this country, *e.g.*, "it is much easier to take land which is already in a good state of fertility and maintain it as such, than to take land which is run down and attempt to restore it."

At the present day, when there is so much talk of inducing and helping men to take up agriculture as a pursuit, may not the following, though based upon the experience of "The West," provide food for thought?

Referring to the various industries which have sprung up in the West the author says:—

"Some of these industries lend themselves to operations on a large scale, while others must be limited. Beef, cattle and sheep may be handled by the thousand, while very few dairies have proved profitable where there are more than 40 or 50 cows. Hogs likewise must not be kept on too large a scale. Hogs will consume many waste products and the chief profit in these animals is found to come from that source. While practically every farmer can raise a few hogs at a profit, there are very few who have been able to make a financial success of raising hogs as an exclusive business."

"From the standpoint of the individual, the man who desires a profitable investment for any considerable amount of money will usually find a greater profit in range cattle or sheep. On the other hand, the man who has very limited capital and whose chief resource is his own labour, can invest this labour to much better advantage in some industry like dairying."

Having in the first part of this book, from which we have quoted, considered the subject generally, the remainder is divided into four parts dealing respectively with Cattle, Sheep, Horses and Swine characteristic of the West. The first of these sections is written by the author and each of the others by an expert on the subject. The complete work covers in detail the management of the live-stock of the West. Illustrations are numerous, good, and thoroughly practical.

- 4.—*Soil Physics and Management.* By J. G. MOSIER and A. F. GUSTAFSON. London and Philadelphia : J. B. Lippincott Co. 8s. 6d.

Soil Physics is the application of physics to soils. It is so closely related to other sciences that it becomes necessary to trespass upon the ground of some of them, notably botany, geology, chemistry and zoology, in order to present certain subjects clearly and completely.

The book is written for three purposes : first as a text-book for agricultural students ; secondly as a reference book for the practical farmer ; and thirdly as an aid to the landowner who desires information in the personal management of his land.

We wonder how many landlords do personally manage their land, or at least have done so in the past, but there is evidence that things are likely to be different in the near future.

To some of our readers the very term soil physics is likely to be new. They may not have realized that every soil is made up of a multitude of particles of matter, much less that the nature of a soil depends largely upon the shape and size of these particles quite apart from the composition or nature of the material of which the particles are composed. They know that soils are light or heavy, warm or cold, dry or damp, etc., but may not have known that all these qualities depend upon the physical nature of the soil. How and why they are so dependent the authors strive to explain.

The particles of which soils are composed vary enormously in size, and are present in very different proportions, the origin of these particles is varied, as also the substances which have in course of time become incorporated with them. Hence the scientific classification of soils is no easy task. The authors enter into this subject very thoroughly, showing finally that soils may be classified under certain types. Of these they enumerate no less than ninety-eight, many of which are subdivided.

We are a practical nation and readers may naturally ask what is the use of this classification ? The answer is : " To make a scientific study of soils and to apply the knowledge to practical agriculture." To do this it is necessary to make a soil survey in which the different types of soil are located on a map.

The authors say :—

" Soils are sufficiently uniform and constant in texture to be divided into distinct types with fairly well defined boundaries, and a soil survey consists in working out these boundaries

in the field and locating them on a map. The type is the unit of the soil survey.

"Objects of a Soil Survey.—The objects of a soil survey may be stated as follows : (a) to take an invoice of the agricultural resources of a country, for they depend first of all upon the soils ; (b) to provide a scientific basis for consistent soil investigation so that time may be used to the best advantage in studying the various types and problems ; (c) to furnish a basis for intelligent recommendations for permanent soil improvement ; (d) to give the farmer who desires to study and improve his soil the information necessary ; (e) in many counties to give to the County agriculturist a valuable asset to aid in his work ; and (f) to give a basis for the introduction of new crops or farm practices. If the work ceases with the mapping of the soils, very little of real value is accomplished, as the soil survey is only preliminary to a more complete investigation. If, however, the soils are analyzed, field experiments carried on, reports published giving the results of the work, and recommendations for improvement and management made, the farmer may avail himself of all this information for improving his soil and his farm management generally."

Having described the origin of the particles of which soils are composed, the forces which have been at work in their formation, and the causes which have resulted in their being finally so placed that they now constitute the various soils known, the authors proceed to examine these particles in more detail. The soil does not consist entirely of mineral matter. It also contains organic constituents or particles which play a very important part in its character and capabilities. Photographs of these particles, as seen under the microscope, are reproduced, the chemical nature of the organic matter is examined, and the value of this organic matter is fully explained, though, as the authors truly say, "it is next to impossible to assign a definite money value to organic matter." Thus every soil may be regarded as a mass of particles of matter, partly, in fact mainly, mineral, and partly organic. What are the physical as distinct from the chemical properties which such particles possess ? To determine these, formulate them, and show their effect on the management of the soil, as also conversely the effect of the treatment of soils on the physical properties of these particles, is the remaining task of the authors.

It is only necessary to give a very brief outline of the nature of this task. The value of the organic particles having been demonstrated,

it becomes evident that in many soils this organic matter must not merely be maintained, but needs to be increased. Having described how this can be done the authors pass on to a consideration of the physical properties of soils generally. As is only natural, the effect of water upon the soil, as also of the soil particles on the water which they receive, comes first and foremost in this study. Upon this study will depend the scientific treatment of the soil as regards drainage where there is an excess of water, as regards irrigation where there is want of water, and as regards tillage in either case. So important is this subject that over 100 pages are devoted to its careful elucidation.

Next in importance comes temperature. It may be asked can we alter the temperature in a soil, is it not "natural"?—using the word in a sense in which it is too often used as an excuse for not doing anything. It can be altered and the authors explain how. Either the farmer is master of his land, or the land will be master of the farmer. Books like this teach the intelligent farmer how to be master.

Other subjects are considered, but there is only one to which we would draw special attention. The study of the physical properties of soils is rather new in this country. Like every new hobby it displaces all others. Thus there has arisen a new school which pins its faith to the physical properties of soil, and, like the followers of most faiths, decries all others. To this new school there is no value in the chemical analysis of soils. It was interesting then to see what view the authors of this book would take upon this subject, should they mention it. The study of soil physics of modern years emanates from the U.S.A. It is now twenty-four years since a notice appeared in this Journal of the celebrated book on "The Soil," written by Prof. King, which summarised and made known to the public the admirable work on the physics of soils previously done in America. Great interest has been taken in this subject ever since, and our knowledge depends largely upon American work. Who then could better judge whether the study of soil physics should replace the chemical study of soils than the authors of this work? Such a question would probably never occur to them; but the following extract from the 1st Appendix to their book which is entitled "Soil Fertility" shows sufficiently clearly what would be their answer:—

"The subject of soil fertility is such a large one and the theories advanced are so varied and conflicting, that the practical farmer is at a loss to know what to do, and as a consequence does nothing. The fertility needs of soils may be

determined in three ways : (1) by chemical analysis, by which the amount of plant food may be determined ; (2) by pot culture experiments in greenhouses under almost perfect conditions ; and (3) by actual field tests, where plant foods of different kinds may be applied and the results compared with those of an equal area of the untreated soil growing the same crop."

Thus it would appear that after the twenty-four years exceptional study of soil physics which has taken place in America, the results of which are so well set forth in this volume, American scientists have not yet learnt to decry the chemical analysis of soils

We commend this book to the three classes for whom it was written, and congratulate the authors upon the interest which they have imparted to the subject by their lucid treatment. It is impossible not to mention the publishers, for the book is beautifully printed, while many of the 200 illustrations which support the text are works of art.

CO-OPERATION AND ORGANIZATION.

5.—*Co-operation in Danish Agriculture.* By HARALD FABER. London : Longmans, Green & Co. 8s. 6d.

6.—*Co-operation in Agriculture.* By G. H. POWELL. London : Macmillan & Co. 6s. 6d.

The above and many other volumes have recently been published upon a subject which is receiving at the present day marked attention. From beginning to end of this year's Journal it is often mentioned, while an admirable article on the subject is reproduced in the Note Book.

The reader may ask, why are the terms Co-operation and Organization used for the title of this notice of books which are both on co-operation. It is because we are of opinion that the two are inseparable. It is not possible to have the one without the other. Whether men co-operate for banking, for purchasing or for selling,

unless it be carried out by a well-organized method on a well thought out system, it must of necessity prove a failure. The reverse is equally true. No organization, however wisely thought out and skilfully started, will ever succeed, if those engaged in, or even remotely forming a part of such organization, fail to co-operate.

At the present day one can scarcely imagine it necessary to say one word in support of the principle or practice of co-operation or organization. Where would this country be to-day had it not been for the introduction of these principles into the production of the weapons of War? Where should we be, had not the same necessity been recognised--may be rather late in the day, but fortunately not too late--in the utilization of the Allied forces? These are illustrations patent to all the world and it is not possible to believe that any man, even one who takes only a casual interest in the events of the day, can have remained blind to them.

It is, however, remarkable that while we see and fully appreciate the great benefits which others derive from a certain course of action, many of us fail entirely to realize that the same principles applied to our own affairs might prove of inestimable value. Such has been the case to a large extent with those engaged in Agriculture, especially in this country, but, fortunately for them, it has not been the experience of Danish farmers.

In the true sense of the term, co-operation among the tillers of the soil is far from modern. When land was common each village or settlement must have had some organization to regulate and form the rules which all should obey. This condition probably existed for centuries until the time came for the partitioning of the land. Then by degrees each occupier became free to follow his own bent and the inclination to do so increased. That condition grew to such an extent that its inevitable consequences began to be felt a drawback, and once again men began to co-operate, not in the old way so as to control their methods of farming, but in a new spirit, so as to obtain all the benefits which might accrue without the disadvantages resulting from the elimination of individual enterprise.

Meantime political and social changes were taking place which ultimately placed the farmer in an entirely new position. Up to a date, which varied in different countries, farmers had been able to live mainly, if not entirely, upon their own produce, while anything they required from outside was paid for in kind. With the introduction of a higher standard of living, the introduction one might say of certain luxuries, it became necessary to pay in cash and this necessity has rapidly increased until at the present

day it has completely ousted the old method, which, in fact, in many instances is made illegal. How was the farmer to obtain cash? Evidently he must borrow and money-lenders soon arose, a class of men who never have had a good reputation and who, in years past, were more unscrupulous usurers than we can easily picture.

The year 1769 stands out prominently in the history of co-operation, for it was in that year that Frederick the Great determined to put a stop to the usury which had preceded that date and gave assent to the formation of an agricultural credit association termed "Die Schlesische Landschaft. It was the starting of co-operative credit. Strange to say that same year, 1769, saw the formation in Glasgow of a co-operative movement for the purpose of buying certain goods. The result of the formation of the agricultural credit banks in Germany was so rapid and striking that it was estimated that in a period of under twenty years they had been the means of saving 400 estate owners from economic ruin. The co-operative scheme of finding money by means of these "Landschaften" gradually spread throughout Germany and was the model on which the Danish system of credit associations was formed. Without these associations Denmark could probably not have attained the advantages which have accrued from its other many forms of co-operation.

The Landschaften were confined to landowners and have been well defined by Wolff* as a system of "Co-operative Mortgage-credit." But the vast majority of the farmers in England, not being owners of the land they cultivate, cannot mortgage that land and cannot therefore adopt this system.

Probably the system most likely to be suitable to this country is the Raiffeisen Credit Banks. A brief account of these credit societies is given by Mr. Hertel in the work translated by Mr. Faber. They are also referred to by Mr. Powell, but a very explicit and detailed account of the formation of such an association is needed before farmers in this country can be expected to co-operate and start such a credit society. If the Government are really anxious to place men on the land and help them, the best course would be to make quite clear to these men how they can best help themselves. Capital is the first essential of successful Agriculture, in fact, it is a vital necessity. The land must be cultivated, the seed bought, money expended on manures, the growing crop tended and finally gathered in, and all the labourers, whether men or horses, fed for

* "Co-operative Banking," by Hy. W. Wolff, London: P. S. King & Son.

months before mother earth repays for the labour and capital expended on her. As Huxley very truly said, "Capital is the mother of labour." If, therefore, we desire more men to put their labour into the land we must first take means to secure the necessary capital, and this seems to be the first step in a national development of co-operation and efficient organization. That this want of capital will be the chief difficulty is shown by the fact that of 1,700 soldiers working on the land who were recently asked by the Surrey County Council to take up small holdings, only 100 desired to do so, and of these only two had the necessary capital (£10 an acre).

The lines along which co-operation has been found of advantage in Agriculture, where it has been adopted on sound principles, may be classified under three heads: (1) Purchase; (2) Production; and (3) Sale. In many places only one aspect of its power has been utilised; others seem to have been entirely overlooked.

Co-operation for the purchase of supplies is the most simple form of co-operation. It needs less machinery for its working, requires less organization, involves less risk, and entails less expense than any other. Any dozen or score of farmers situated near to a railway station may easily co-operate for this purpose. Each farmer would write out the quantity and kind of manure or cake he required, and hand his list to whoever was for the time being selected as manager. The total quantity—of say superphosphate or linseed cake—required would be ordered and forwarded as one consignment. Then each purchaser would have to fetch his portion from the Station or store-room hired for the purpose. The total cost of the out of pocket expenses of the manager, of the hire of store-room, of analysis of the consignments, and of any labour employed would be met by a charge to each purchaser in proportion to his purchase. Let any dozen farmers try this system once and we have no hesitation in saying it would not be the last time they would combine for the purchase of requisites. The illustration is a simple one. It would soon be found necessary to develop the system; to extend it to the purchase of many requisites other than Fertilisers and Feeding Stuffs. In fact there are no articles which are in common use by these twelve farmers, *e.g.*, coals, seeds, implements, etc., which could not be thus purchased and consigned at less cost, and with greater certainty of obtaining good quality, than could be ensured if they were purchased separately.

Where there is a special industry—as, for example, egg or fruit production—requiring say special forms of boxes or baskets for the marketing of the products, co-operative purchase of these articles is of special advantage and may attain to a prodigious business.

Thus in America in 1911, one federation of fruit-growers co-operative associations delivered more than 12 million boxes to its members and nearly £10,000 worth of orchard and other packing-house supplies.

It is impossible to read the agricultural papers and the reports of agricultural analysts without recognising that feeding stuffs, manures and seeds are liable to be inferior or even adulterated, while they are frequently sold at prices far above their intrinsic value. How is it that such a state of affairs exists? It is due partly to the inherent desire of men to try and get a "cheap" article. This is sometimes due to want of capital and may then be excusable, but when not so due it shows lack of knowledge, for has not experience taught men to associate the terms "cheap and nasty," and does not a man's own common sense tell him that he would not sell a good article at an inadequate price, and therefore he cannot expect other men to do so.

Were farmers to combine to purchase these indispensable requisites in bulk from reputable firms, they would be able to ensure the quality, for one analysis of the bulk would serve where to-day twenty would be required to check individual deliveries; they would save in the cost of carriage and of distribution, and also in the price. This is no theoretical assumption. It is a proved fact which can be vouched for by every man who has purchased through his co-operative association, and it has been well brought out in the books under notice.

The application of co-operation to Production and Sale is even of greater importance than to that of purchase. While with us, co-operation has been mainly confined to Purchase, with what one might term a selfish motive, or rather direct benefit to self, in Denmark and generally in other countries it has been prompted largely by the desire to produce uniform and high quality goods for the benefit of others. As is well known, the remarkable dairy industry of Denmark has been evolved by means of co-operation. It is a wonderful tale, and illustrates that remarkable progress which can be ensured in every industry by the working together of Science and Practice. For certainly Denmark owes her success, and the success of her co-operative movements, quite as much to her scientific men as to her practical men. And it is only too often forgotten that those countries which have copied her example have as much benefited by this scientific work as have the men for whom it was done.

Success and effort in one direction invariably open out new lines for progress. Thus, co-operation in milk supply led to

co-operation for the improvement of cattle and swine, and for the introduction of slaughter houses.

Similarly, in America, the main object has been to supply goods of uniform and high quality to the public. Here again dairy products, eggs, grain and cotton, have been some of the chief lines along which it has developed. But perhaps the most striking illustration of the success achieved is afforded by the fruit industry, so well and fully described by Mr. Powell.

These books teach great lessons, lessons which it is high time that agriculturists should learn, think over, and act upon.

7.—*Injurious Insects and Useful Birds.* By F. L. WASHBURN, M.A.
London : J. B. Lippincott Co. 7s. 6d.

This book is one of a series of Farm Manuals, and is written by an American Professor of Entomology for students in high schools and agricultural colleges. There is no need to assume that, therefore, it is only suitable for American students and farmers. It is quite true that there are in America insects which fortunately do not give trouble here at present. In the majority of cases, however, those which affect American agriculture are common to the two countries. Again at the present time great interest is being taken in Nature Study, and few objects are more adapted for this than Insects and Birds. Apart from the training in observation which they afford, their study has also a practical and useful side, one in which parents are as much interested as the students, so that farmers recognise the value of this study. The more parents are interested in the education of their children the better it will be for the educational system of this country. Many of the faults from which we have suffered in the past are largely due to the apathy of parents generally in both the subjects and the methods employed for the education of their children. Any book which may tend to remedy these defects of the past is welcome, and this book, we consider, is likely to add greatly to the interest in and utility of the study of insect life.

Its most striking feature is the number and excellence of the

illustrations which illumine the text. Bare description of any object, no matter how skilful that description may be, is never equal to description combined with an illustration. Of course it is best when such illustration can be the real object and, if possible, alive. This book contains over four hundred illustrations, some in colours, many from photographs, together with the diagrammatic drawings essential to the study of any science.

The author does not intend these to take the place of living objects. Hence, quite early in his book, so soon, in fact, as he has given some outline of the external structure of insects, he describes the methods of collecting and preserving insects, and urges the all important duty of keeping records. As he truly says:—"The necessity of having specimens in a collection carefully labelled, and with all data where they can be referred to, cannot be too strongly emphasized."

Having fully described the various Insecticides and the methods of Spraying and Fumigation employed to combat insect pests, the author passes on to a detailed description of the various insects which cause injury. Either of two methods is available for this purpose. The one is to follow the scientific classification of insects and state in connection with each order or class what trees, fruits or crops are affected by members of it. The second method is to take each tree, fruit or crop and then describe the insects that affect it. The latter is the course adopted by the author, and it is certainly the one which appeals to the student and the farmer and more especially to those who are commencing Nature Study.

The apple tree is the first of the trees considered, and the pear, plum, and cherry follow. Then the various berries, field crops, pastures, vegetable garden plants, and flowers come under observation. Each has its insect pests, and these are described briefly, yet clearly, with such advice as to control as can be given.

Only a few years ago dwellers in London had in Hyde Park an illustration such as is rarely seen of the ravages which trees may suffer from an insect pest. It is seldom that such a plague is noticed, yet the damage done by insects to what the author terms "shade trees," is in the aggregate considerable.

Even this list does not complete the roll of these destructive pests. As the readers of the "Journal" well know from the interesting articles of Mr. Bastin, there are insects which affect men, food, and the household generally, while others affect our live stock and poultry. All are treated by the author. It is a remarkable army of destruction.

Fortunately these insects have their foes, some few of which are

themselves insects, and others bacteria or moulds. Their greatest enemies, however, are birds, and these are not only described by the author but are also well illustrated in colours. Unfortunately some birds are of doubtful utility, such as the house-sparrow, and the author "does not hesitate to urge its destruction" even though some of the methods he suggests "may appear rather harsh to bird lovers.

We have tried to give some indication of the wide field the Author has covered, sufficient we think to show those for whom the book was written that it is worthy of their study.

8.—"*Fifty Years of a Showman's Life.*" By THOS. F. PLOWMAN.
London: John Lane.

The courtesy of the Publisher in sending us an advance copy of this book is entitled to some acknowledgment, but the close association of the author with the Bath and West Society precludes our doing more than notifying its publication and giving a general idea of its purport. Naturally, the Society plays a prominent part in this budget of old memories, but anyone expecting to find in it anything of the nature of a cut-and-dried official record of the Society's doings will be disappointed. It must be admitted, however, that the author warns his readers of what they may expect, for, in his introductory chapter, he says:—"Let me forestall criticism by saying that I propose to indulge in many trivialities, to put on record incidents that are quite unimportant in themselves, but which may serve to illustrate the doings of the little world in which I have moved. To form an adequate idea of any particular phase of life, we must take cognizance of those minor details of which it is largely made up and which throw so much light upon the underlying motives that are the springs of action. There is, in addition, a certain element of interest in being shown what some of us are like when we are not on parade in full regimentals.

"So in the telling of my story I do not propose to ransack my memory for recollections of incidents of great pith and moment, for these are to be found in newspapers and formal records. My

old memories are far removed from 'official utterances,' with which they have no affinity, though I may, perhaps, remark, with some knowledge of officialdom, that it does not follow that they are the less reliable on that account. Official communications take life very seriously and rarely lift the veil which conceals the world behind the scenes from the gaze of ordinary mortals; whereas reminiscences, if they are good for anything, generally do, and herein lies the main distinction between the two. For those who, in the language of metaphor, prefer their leg of mutton without any trimmings, there are many excellent Parliamentary Blue Books obtainable at waste-paper price, which will meet their case much better than anything I can supply.

"From the foregoing remarks, I think it will be perceived that, whatever the shortcomings—and they are many—appertaining to what I am about to unfold, I do not propose to lay myself open to the charge of lack of frankness or of neglecting to take my readers into full confidence. Further, though I shall be serious on occasion, I shall strive, with a pertinacity worthy of a better cause, to gather up and exploit any crumb of comedy coming my way—'for 'tis my nature to.' If I needed a defence for this, I should fall back upon Canon Liddon, who held that 'light-heartedness is at once the right and the duty of a Christian whose conscience is in fairly good order.'

"My endeavour will be to depict from personal observation the inner life of the agricultural showyard and the manners and customs of its inhabitants, including those responsible for its control; and to point some contrasts between yesterday and to-day in agricultural methods and in the characteristics of those who pursue them. I purpose casting my retrospective net sufficiently wide as to embrace within its meshes any matters, whether inside or outside the showyard, which naturally arise out of my agricultural experiences; the intent being to portray various persons and things and such phases of life as have come within my province during my half-century's association with the farming interest."

The ordinary showman—Barnum and Lord George Sanger, to wit—has enlightened the outside world by a recital of his experiences in pursuit of his vocation and has, metaphorically, taken behind the scenes of his profession all who cared to go there. But this example, so far as we know, has not been followed, at any rate with corresponding particularity, by any agricultural showman other than the author of this work. In view of the fact that, owing to serious illness having curtailed his physical activities, he has felt compelled to ask the Society to release him from the burden of

office, one may regard the book as a final summing up of a long and—as the author puts it—happy association with men and things pertaining to Agriculture.

Those who have read the writer's previous recollections of town-life, "*In the Days of Victoria*," will hardly need to be told that light-hearted optimism is the prevailing note of his latest work; hence, all pessimists who desire to hold fast to their faith had better leave it severely alone.

The book is dedicated, by permission, to the present President of the Bath and West Society (Lord Coventry) and the Council "in grateful remembrance of a long and happy association."

It has many portraits of well-known agriculturists, both living and dead, in illustration of the text.

APPENDIX.

Bath and West and Southern Counties Society.

OBJECTS OF THE SOCIETY AND PRIVILEGES OF MEMBERSHIP.

ANNUAL EXHIBITIONS.

THE Society annually holds an Exhibition in some city or town in England or Wales. Each section of the Society's district is visited at intervals, so that most Members have an opportunity of seeing the Show in their own neighbourhood every few years. Prizes to a large amount are given for Horses, Cattle, Sheep, Pigs, Farm Produce, &c. Provision is also made for the exhibition of Agricultural Implements and Machinery, Seeds, Cattle Foods, Artificial Manures, and articles of general utility. A substantially built and completely equipped Working Dairy on a large scale is a special feature of these Exhibitions. Here explanatory demonstrations and comparative tests of implements and processes are carried on, with the assistance of well-known practical and scientific experts, and Butter-making Competitions are held. Among the features of the Annual Meeting are Shoeing, Milking and other Competitions, Poultry and Horticultural Shows, and Exhibitions illustrative of Bee-keeping, Home Industries, Art-Manufactures, Nature Study and Forestry.

Membership entitles to free admission to the Annual Exhibition, and also to the Grand Stand overlooking the Horse and Cattle Ring, to the Reserved Seats in the Working Dairy, and to the use of the Members' Special Pavilion for Luncheons, Reading, Writing, &c.

Entries can be made by Members selected on or before the last Tuesday in January preceding the Show) at half the Fees payable by Non-Members.

THE JOURNAL.

All Members receive free of charge the Society's Journal, which is published annually bound in cloth. It has for its aim the dissemination of agricultural knowledge in a popular form, and, in addition to original articles by well-known agricultural authorities, it contains particulars of the Society's general operations, full reports of its experimental and research work, prize awards, financial statements, lists of Members, reviews of new books on agriculture, &c. (The price of the Journal to non-Members is 6s. 6d. post free.)

CHEMICAL AND OTHER FACILITIES.

The Society has a Consulting Chemist from whom Members can obtain analyses and reports at reduced rates of charge. An arrangement has also been made under which Members of the Society can obtain, free of charge, from the National Fruit and Cider Institute at Long Ashton, analyses of cider apples and perry-pears, and, with a view to assisting farmers and others in dealing with insect and other pests which affect agriculture, horticulture, &c., the Council have availed themselves of an offer from the Board of Economic Biology of the University of Bristol to investigate the nature of any insect or other pest and report upon it free of charge.

EXPERIMENTS.

Experiments on crops are conducted at experimental stations in various parts of the Kingdom, and *Members are enabled to take part in these and to receive reports thereon.*

ART-MANUFACTURES, NATURE STUDY, FORESTRY, &c.

One of the objects for which the Society was founded was the encouragement of Arts as well as Agriculture, and, to this end, exhibitions are held of Art-Manufactures and of work representative of Arts and Handicrafts. Exhibitions are also held illustrating Nature Study, as a branch of Education; the Science of Forestry, &c.

TERMS OF MEMBERSHIP.**ANNUAL SUBSCRIPTIONS.**

Governors, not less than	..	..	..	..	£2
Ordinary Members, not less than	..	..	..	..	£1
Tenant Farmers, the rateable value of whose holdings does)					10s.
not exceed £200 a-year, not less than					

Governors, who are eligible for election as President or Vice-President, are entitled, in addition to the privileges already mentioned, to an extra Season Ticket for the Annual Exhibition and for the Grand Stand, &c. Governors subscribing more than £2 are entitled to a further Ticket for every additional £1 subscribed.

Members subscribing less than £1 are entitled to all the privileges of Membership except that of entering Stock at reduced fees, and their admission Ticket for the Annual Show is available for *one day only* instead of for the whole time of the Exhibition.

LIFE COMPOSITIONS.

Governors may compound for their Subscription for future years by payment, in advance, of £20; and Members by payment, in advance, of £10. Governors and Members who have subscribed for twenty years may become Life Members on payment of half these amounts.

Any person desirous of joining the Society can be proposed by a Member, or by

THOS. F. PLOWMAN,
Secretary and Editor.

3, Pierrepont Street, Bath.

Telegraphic Address—"PLOWMAN, BATH."

Telephone No. 610.

Bath and West and Southern Counties Society.

GENERAL LAWS.

As revised in accordance with the Report of a Special Committee; which Report was received and adopted by the Annual General Meeting of Members, held on May 30, 1895.

COMPOSITION OF THE SOCIETY.

I. The Society shall consist of a President, Vice-Presidents, Trustees, Council, Treasurer, Secretary, and Members.

OBJECTS.

II. The Society shall have the following objects:—

- a. To hold Exhibitions of breeding stock, agricultural implements, and such other articles connected with agriculture, arts, manufactures or commerce, as may be determined upon by the Council.
- b. To conduct practical and scientific investigations in agriculture.
- c. To promote technical education in agriculture by providing means of systematic instruction.
- d. To publish a Journal for circulation.

SUBSCRIPTIONS.

III. The Annual Subscription for Members shall be as follows:—

Governors (who are eligible for election as President or Vice-President), not less than	£2
Ordinary Members, not less than	£1
Tenant Farmers (the rateable value of whose holdings does not exceed £200 a-year), not less than	10s.

IV. The payment of £20 in one sum shall constitute a Governor for life, and of £10 in one sum an Ordinary Member for life; but any Governor who has subscribed not less than £2 annually for a period of twenty years may become a Life Governor on the further payment of £10 in one sum; and any Ordinary Member, who has subscribed not less than £1 annually for the same period may become a Life-Member on the further payment of £5 in one sum.

V. Subscriptions shall become due and be payable in advance on the 1st of January in each year or as soon as the Subscriber has been elected a Member. When the election takes place during the last quarter of the year the subscription payable on election will be considered as applying to the ensuing year.

VI. A Member shall be liable to pay his subscription for the current year unless he shall have given notice, in writing, to the Secretary before January 1st of his intention to withdraw.

GOVERNING BODY.

VII. The entire management of the Society—including the making of Bye-laws, election of Members, determining the Prizes to be awarded, appointing Committees, fixing the Places of Meetings and Exhibitions, appointing or removing the Treasurer, Secretary, and such other officers as may be required to carry on the business of the Society—shall be vested in the Council, who shall report its proceedings at the Annual Meetings of the Society.

VIII. The Council shall consist of the Patron (if any), President, Vice-Presidents, Trustees, and Treasurer (who shall be *ex-officio* Members), and of sixty-six elected Members.

ELECTION OF PRESIDENT, VICE-PRESIDENTS, TRUSTEES, AND COUNCIL.

IX. The election of a President for the year, of any additional Vice-Presidents or Trustees, and of the Members of Council representing the Divisions named in Law X., shall take place at the Annual Meeting of the Society, and they shall enter into office at the conclusion of the Exhibition during which such Annual Meeting has been held.

X. The sixty-six Members of the Council referred to in Laws VIII. and IX. shall consist of fifty-eight persons residing or representing property in the following Divisions, viz. :—

Twelve from the Counties of Devon and Cornwall, which shall be called the Western Division ;

Twenty-four from the Counties of Somerset, Dorset, and Wilts, which shall be called the Central Division ;

Twelve from the Counties of Hants, Berks, Oxon, Bucks, Middlesex, Surrey, Sussex, and Kent, which shall be called the Southern Division ; and

Ten from the Counties of Worcester, Gloucester, Hereford and Monmouth, and the Principality of Wales, which shall be called the North-Western Division.

The remaining eight shall be elected (irrespective of locality) from the general body of members, and shall form a Division which shall be called the "Without Reference to District" Division.

XI. One-half of the elected Members in each of the five Divisions named in Law X. shall retire annually by rotation, but shall be eligible for re-election.

XII. The Council shall have power to nominate a President, Vice-Presidents, Trustees, and Members of Council for the approval of the Annual Meeting, and to fill up such vacancies in their own body as are left after the Annual Meeting, or as may from time to time occur during the interval between the Annual Meetings.

XIII. Nominations to offices, election to which is vested in the whole body of Members, must reach the Secretary ten days before the meeting at which such vacancies are to be filled up.

MEETINGS.

XIV. The Annual Meeting of the Society shall take place during the holding of the annual Exhibition.

XV. Special General Meetings of the Society may be convened by the President on the written requisition of not less than three Members of Council ; and all Members shall have ten days' notice of the object for which they are called together.

XVI. No Member of less than three months' standing, or whose subscription is in arrear, shall be entitled to vote at a Meeting.

EXHIBITIONS.

XVII. The Annual Exhibitions of the Society shall be held in different Cities or Towns in successive years.

XVIII. All Exhibitors shall pay such fees as may be fixed by the Council. Members subscribing not less than £1 per annum, who have been elected previous to February 1st, and have paid the subscription for the current year, shall be entitled to exhibit at such reduction in these fees as the Council shall determine.

PRIZES.

XIX. All prizes offered at the cost of the Society shall be open for competition to the United Kingdom.

XX. No person intending to compete for any prize offered at the annual Exhibition shall be eligible to act as a judge or to have any voice in the selection of judges to award the premiums in the department in which he exhibits.

XXI. If it be proved to the satisfaction of the Council that any person has attempted to gain a prize in this, or in any other society, by a false certificate or by a misrepresentation of any kind, such person shall thereupon be, for the future, excluded from exhibiting in this Society.

JOURNAL.

XXII. The Proceedings of the Society, Awards of Prizes, Financial Statements and Lists of Officers, Governors, and Members, shall be printed annually in the Society's *Journal*, and every Governor and Member, not in arrear with his subscription, shall be entitled to receive one copy, free of expense, and there shall be an additional number printed for sale.

POLITICS.

XXIII. No subject or question of a political tendency shall be introduced at any Meeting of this Society.

ALTERATIONS IN LAWS.

XXIV. No new General Law shall be made or existing one altered, added to or rescinded, except at an Annual or Special General Meeting, and then only provided that a statement of particulars, in writing, shall have been sent to the Secretary at least twenty-one days previous to the Meeting at which the question is to be considered.

List of Officers,

1913-1919.

PATRON.

HIS MOST GRACIOUS MAJESTY THE KING

PRESIDENT.

THE RIGHT HON. THE EARL OF COVENTRY.

TRUSTEES.

*BATH, THE MARQUIS OF, K.G., Longleat, Warminster.

EDWARDS, C. L. F., The Court, Axbridge, Somerset.

VICE-PRESIDENTS.

ALLEN, J. D.	Springfield House, Shepton Mallet
BADCOCK, H. J.	Broadlands, Taunton
BAKER, G. E. LLOYD	Hardwicke Court, Gloucester
*BATH, MARQUIS OF, K.G.	Longleat, Warminster
*BEAUFORT, DUKE OF	Badminton, Chippenham
BENYON, J. HERBERT	Englefield House, Reading
*BUTE, MARQUIS OF	The Castle, Cardiff
*CLINTON, LORD	Heanton Satchville, Dolton, N. Devon
DEVONSHIRE, DUKE OF	Chatsworth, Derbyshire
*DIGBY, LORD	Minterne, Cerne Abbas
*DUCIE, EARL OF	Tortworth, Falfeld, R.S.O.
EDWARDS, C. L. F.	The Court, Axbridge, Somerset
HANBLEDEN, VISCOUNT	Greenlands, Henley-on-Thames
HOBHOUSE, RIGHT HON. H.	Hadspen House, Castle Cary
*LANSDOWNE, MARQUIS OF, K.G.	Bowood, Calne
*LLEWELYN, SIR J. T. D., Bart.	Penllergaer, Swansea
MORETON, LORD	Sarsden House, Chipping Norton
NEVILLE GRENVILLE, R.	Butleigh Court, Glastonbury
*PLYMOUTH, EARL OF	Hewell Grange, Bromsgrove

. Those to whose names an asterisk (*) is prefixed have filled the office of President.

VICE-PRESIDENTS—continued.

*PORTMAN, VISCOUNT	Bryanston, Blandford
*RADNOR, EARL OF	Longford Castle, Salisbury
SHELLEY, SIR J., Bart. . . .	Shobrooke Park, Crediton
SILLIFANT, A. O.	Culmleigh, Stoke Canon, Exeter
SOMERSET, DUKE OF	Maiden Bradley, Bath
STRACHIE, LORD	Sutton Court, Pensford, Somerset
TEMPLE, EARL	Newton St. Loe, Bristol
WALERAN, LORD	Bradfield, Cullompton

THE LORD WARDEN OF THE STANNARIES.

THE SECRETARY AND KEEPER OF THE RECORDS OF THE DUCHY OF
CORNWALL.

THE RECEIVER-GENERAL OF THE DUCHY OF CORNWALL.

. Those to whose names an asterisk (*) is prefixed have filled the office of President.

EX-OFFICIO MEMBERS.

THE PATRON.
THE PRESIDENT.

THE VICE-PRESIDENTS.
THE TRUSTEES.
THE TREASURER.

ELECTED MEMBERS.

WESTERN DIVISION (DEVON AND CORNWALL).

(12 Representatives.)

Elected in 1917.

Name.	Address.
BOSCAWEN, REV. A. T.	Ludgvan Rectory, Long Rock, R.S.O., Cornwall
DAW, J. E.	Exeter
LEVERTON, W.	Woolleigh Barton, Beaford, N. Devon
LOPES, SIR HENRY	Maristow, Roborough, S. Devon
Y. B., Bart.	Devon
MARTYN G.	Liskeard, Cornwall
MORLEY, EARL OF	Saltram, Plympton, Devon

Elected in 1918.

Name.	Address.
BUCKINGHAM, REV. THE	Rectory, Doddish-Pree, combsleigh, Exeter
GIBBS, MAJOR A. H.	11, Marlborough Buildings, Bath
MOORE-STEVENS, COL.	Winscott, Torrington, Devon
R. A.	Devon
SHELLEY, J. F.	Posbury House, Crediton
STUDDY, T. E.	Mazonet, Stoke Gabriel, Totnes
WILLIAMS, JOHN	Scorrier House, Scorrier, Cornwall

CENTRAL DIVISION (SOMERSET, DORSET, AND WILTS).

(24 Representatives.)

CLARK, W. H.	Rutland Cottage, Combe Down, Bath
FARWELL, CAPT. E. W.	Queen's Parade, Bath
GORDON, G. H.	The Barn House, Sherborne, Dorset
HILL, MAJOR V. T.	Mendip Lodge, Langford, Bristol
HOARE, SIR H. H. A., Bart.	Stourhead, Zeals, S.O., Wilts
HURLE, J. O.	Brislington Hill, Bristol
KNIGHT, S. J.	Walnut Farm, East Dundry, Bristol
RAWLENCE, E. A.	Newlands, Salisbury
RAWLENCE, G. N.	Salisbury
SOMERVILLE, A. F.	Dinder House, Wells
WATSON, CAPT. THE	Cormiston, Milverton, Somt.
HON. T. H.	Somt.
WHITE, A. R.	Charnage, Mere, Wilts

FOX, R. A.	Yate House, Yatè, Glos.
GIBSON, J. T.	Warren House, Wington
NAPIER, H. B.	Long Ashton, Clifton, Bristol
NICHOLS, G.	49, Broad Street, Bristol
PARRY-OKEDEN, LT.-COL. U. E. P.	Turnworth, Blandford, Dorset
SANDERS, R. A., M.P.	Barwick House, Yeovil
TUDWAY, C. O.	The Cedars, Wells, Somt.
WYNFORD, LORD	Wynford House, Marden Newton, Dorset

SOUTHERN DIVISION (HANTS, BERKS, OXON, BUCKS, MIDDLESEX, SURREY, SUSSEX AND KENT).

(12 Representatives.)

ASHCROFT, W.	13, The Waldrons, Croydon
BURRELL, SIR M. R., Bart.	Knepp Castle, Horsham, Sussex
COBB, H. M.	Higham, Kent
CUNDALL, H. M., I.S.O., F.S.A.	4, Marchmont Gardens, Richmond, Surrey
DRUMMOND, H. W.	Board Room L & S.W.R., Waterloo Stn., London.
LLEWELLYN, L. T. E.	Hackwood, Basingstoke

ACLAND, Rt. Hon. F. DYKE	93, Bedford Gardens, Campden Hill, London, W.
BEST, MAJOR T. G.	East Carleton Manor, Norwich
JARVOISE, F. H. T.	Herriard Park, Basingstoke
LATHAM, T.	Dorchester, Oxon
RUTHERFORD, J. A.	Highclere Estate Office, Newbury
SUTTON, E. P. F.	Sidmouth Grange, nr. Reading

NORTH-WESTERN DIVISION (WORCESTERSHIRE, GLOUCESTERSHIRE, HEREFORDSHIRE, MONMOUTHSHIRE AND WALES).

(10 Representatives.)

ACKERS, C. P.	Huntley Manor, Gloucester
ALEXANDER, D.	Cardiff
ALEXANDER, H. G.	5, High Street, Cardiff
BLEDISLOE, LORD	Lydney Park, Gloucester
DRUMMOND, COL. F. D. W.	Cawdor Estate Office, Carmarthen

ALLSEBROOK, A.	Link Elm, Malvern Link
BEST, CAPT. W.	Vivod, Llangollen
COTTERELL, SIR J., Bart.	Garnons, Hereford
LIPSCOMB, G.	Margam Park Estate Office, Port Talbot
MASON, F. F.	Swansea

WITHOUT REFERENCE TO DISTRICT DIVISION.

(8 Representatives.)

EVANS, H. M. G.	Plasissia, Llangennech, Carmarthen
LEWIS, COL. H.	Green Meadow, near Cardiff
MASTERS, A.	Kyneton, Thornbury, Glos.
WILLIAMS, MAJOR JESTYN	Kilforge, Holme Lacy, Hereford.

KNOLLYS, O. R.	Weekley, Kettering
PORTMAN, HON. C. B.	Goldicott, Stratford-on-Avon

NAPLES, H. B.
NEWELL, CHENNAULT, R.
ST. JOHN, JOHN
TUDWAY, C. F.

List of Officers, 1918-1919.

IMPLEMENT REGULATIONS.

SHELLEY, SIR J., Bart., *Chairman.*

BATH, MARQUIS OF. K.G.	MARTYN, G.	NAPIER, H. B.
BEST, CAPT. W.	MASON, F. F.	NEVILLE GRENVILLE, R.
EDWARDS, C. L. F.	MOORE-STEVENS, COL.	STUDDY, T. E.
	R. A.	

JOURNAL.

ACLAND, Sir C. T. D., Bart., *Chairman.*

BAKER, G. E. LLOYD	HOBHOUSE, RIGHT HON. H.
BLEDISLOE, LORD	

JUDGES' SELECTION.

SILLIFANT, A. O., *Chairman.*

ALEXANDER, D.	GORDON, G.	PARRY-OKEDEN, LIEUT.-
ALEXANDER, H. G.	HOARE SIR H. H. A., Bart.	COL. U. E. P.
ALLEN, J. D.	LATHAM, T.	SHELLEY, SIR J., Bart.
ASHCROFT, W.	MOORE-STEVENS, COL.	WYNFORD, LORD
	R. A.	

RAILWAY ARRANGEMENTS AND ADVERTISEMENTS.

ALEXANDER, D.	DRUMMOND, H. W.	SHELLEY SIR J., Bart.
COVENTRY, EARL OF	MASON, F. F.	

(With power to add to their number.)

SCIENCE AND ART.

BATH, MARQUIS OF, K.G., *Chairman.*

CUNDALL, H. M. (I.S.O., F.S.A.)	FARWELL, CAPT. E. W.	LLEWELYN, SIR J. T. D.,
DAW, J. E.	HOBHOUSE, RT. HON. H.	Bart.
EVANS, H. M. G.	LEGARD, A. G.	NAPIER, H. B.
	LIPSCOMB, G.	RUTHERFORD, J. A.

(With power to add to their number.)

SELECTION.

THE CHAIRMEN OF ALL OTHER COMMITTEES.

SHOW PLACE AND DATE.

CHAIRMEN OF THE ALLOTMENT, CONTRACTS, DAIRY, FINANCE, FORESTRY,
IMPLEMENT REGULATIONS, RAILWAY ARRANGEMENTS, SCIENCE AND ART,
AND STOCK PRIZE SHEET COMMITTEES.

(With power to add two Local Members to their number)

STOCK PRIZE SHEET.

SILLIFANT, A. O., *Chairman.*

ALEXANDER, D.	EVANS, H. M. G.	PORTMAN, HON. C. B.
ALEXANDER, H. G.	GIBBS, MAJOR A. H.	SHELLEY, SIR J., Bart.
ALLEN, J. D.	HOARE, SIR H. H. A.,	SUTTON, E. P. F.
ALLSEBROOK, A.	Bart.	WHITE, A. R.
ASHCROFT, W.	LATHAM, T.	WILLIAMS, MAJOR JESTYN
BUCKINGHAM, REV. PREB.	LEVERTON, W.	WYNFORD, LORD
CLARE, W. H.	MOORE-STEVENS, COL.	
COTTERELL, SIR J., Bart.	R. A.	

WORKS.

EDWARDS, C. L. F., *Chairman.*

BATH, MARQUIS OF, K.G.
BEST, CAPT. W.

NAPIER, H. B.
STUDDY, T. E.

Stewards.

Cattle, Sheep and Pigs.

ASHCROFT, W.
MOORE-STEVENS, COL. R. A.

Horses.

ALEXANDER, D.
WYNFORD, LORD

Cider.

FARWELL, CAPT. E. W.

Horticulture.

BOSCAWEN, REV. A. T.

Dairy.

SOMERVILLE, A. F.

Poultry.

STUDDY, T. E.

Experiments.

ASHCROFT, W.

Science and Art and Music.

CUNDALL, H. M. (I.S.O., F.S.A.)

Finance.

DAW, J. E.
NAPIER, H. B. GIBBS, MAJOR A. H.

Shoeing.

LATHAM, T.

Forestry.

LIPSCOMB, G.

Yard.

EDWARDS, C. L. F.
BEST, CAPT. W.
BATH, MARQUIS OF, K.G.
STUDDY, T. E.

Other Honorary Officials.

Treasurer—LUTTRELL, C. M. F.

Chaplain.

BOSCAWEN, REV. A. T.

Permanent Officials.

Secretary and Editor—PLOWMAN, THOMAS F.

Associate Editor.

LLOYD, F. J. (F.C.S.)

Consulting Chemist.

VOELCKER, DR. J. A. (M.A., F.I.C.)

Veterinary Inspector.

PENBERTHY, Prof. J. (F.R.C.V.S.)

Auditor.

GOODMAN, F. C. (*Chartered Accountant*)

Supintendent of Works.

AYRE, H. C.

Annual Exhibitions.

(xi.)

Year.	Place Visited.	Local Subscrip- tion.	Prizes.			President.	Admissions.		
			Local Com- mittee.	Local Societies.	Local Resi- dents.		Total Local Contri- bution.	On 2/6 Days.	On 1/- Days.	Total.
1852	Taunton .	£ 210	£ ..	£ ..	£ ..	Lord Portman	..	..	..
1853	Plymouth	450	..	..	..	Sir T. D. Acland, Bart.	..	..	..
1854	Bath .	450	..	..	..	William Miles, M.P.	..	..	..
1855	Tiverton .	450	..	..	..	Earl Fortescue	..	..	..
1856	Yeovil .	450	..	..	..	C. A. Moody, M.P.	..	..	..
1857	Newton Abbot	700	..	..	..	Lord Courtenay	..	..	..
1858	Cardiff .	800	..	..	..	Lord Courtenay	..	..	..
1859	Barnstaple	800	85	81	81	John Sillifant .	..	..	..
1860	Dorchester	900	..	..	..	Lord Rivers .	10,709	11,949	22,658
1861	Truro .	900	..	..	..	J. W. Buller, M.P. .	15,201	14,220	29,421
1862	Wells .	900	..	..	..	Sir T. D. Acland, Bart.	10,578	4,775	15,353
1863	Exeter .	900	..	..	..	Marquis of Bath	15,635	19,284	34,919
1864	Bristol .	1000	106	50	50	Earl Fortescue .	22,377	65,678	88,055
1865	Hereford .	900	358	..	..	Lord Taunton .	16,575	35,261	51,836
1866	Salisbury .	900	57	..	..	(Earl of Portsmouth	7,288	18,737	26,025
1867	Salisbury .	..	..	..	..	J. Trenayne .	7,502	16,702	24,204
1868	Falmouth	900	..	..	..	Sir J. T. B. Duckworth, Bart.	11,393	19,495	30,888
1869	Southampton	900	132	18	18	Earl of Carnarvon .	15,340	41,290	56,630
1870	Taunton .	900	..	..	..	Sir S. H. Northcote, Bart., C.B., M.P.	17,952	33,653	51,605
1871	Guildford .	900	110	..	..	Earl of Cork .	10,656	23,406	34,062
1872	Dorchester .	800	..	400	10	Duke of Marlborough, K.G.	12,791	21,517	34,308
1873	Plymouth	800	..	..	..	Earl of Mount-Edgumbe.	16,665	45,744	62,409
1874	Bristol .	800	403	..	..	Sir Massey Lopes, Bart., M.P.	37,329	72,791	110,120
1875	Croydon .	800	245	..	..	R. Benyon, M.P. .	14,518	26,028	40,546
1876	Hereford .	800	381	..	..	Earl of Ducie .	16,396	32,645	49,041
1877	Bath .	800	215	..	..	Marquis of Lansdowne	27,625	48,852	76,477
1878	Oxford .	800	..	170	6	Earl of Jersey .	12,414	26,995	39,409

ANNUAL EXHIBITIONS—continued.

Year.	Place Visited.	Local Subscription.	Prizes.			President.	Admissions.			Total.
			Local Committee.	Societies.	Local Residents.		On 5/- Day.	On 2/6 Days.	On 1/- Days.	
		£	£	£	£					
1879	Exeter	800	..	10	810	Earl of Morley	..	14,034	40,533	55,167
1880	Worcester	800	..	254	1054	Earl of Coventry	..	8,415	37,675	46,090
1881	Tunbridge Wells	800	245	34	1079	Marquis of Abergavenny	..	13,368	33,236	46,604
1882	Cardiff	800	200	198	1215	Lord Tredegar	..	23,941	38,680	62,621
1883	Bridgwater	800	78	..	878	Lord Brooke, M.P.	..	17,171	31,241	48,412
1884	Maidstone	800	310	33	1218	Viscount Holmesdale	..	13,501	31,053	44,554
1885	Brighton	800	227	33	1142	Viscount Hampden	..	9,637	39,851	49,488
1886	Bristol	800	525	..	1325	Lord Carlisle	..	29,580	70,999	100,579
1887	Dorchester	800	..	112	912	Earl of Ilchester	..	8,860	29,846	38,706
1888	Newport (Mon.)	800	100	..	900	Lord Tredegar	..	14,878	38,567	53,445
1889	Exeter	800	294	..	10	Lord Clinton	..	16,405	36,195	52,600
1890	Rochester	800	294	..	26	Earl of Darnley	..	3,480	48,314	51,794
1891	Bath	800	50	103	1053	Earl Temple	..	23,510	52,185	75,695
1892	Swansea	800	200	100	1110	Sir J. D. T. Llewelyn, Bart.	..	18,364	54,609	72,973
1893	Gloucester	800	400	..	1200	Lord Fitzhardinge	..	14,272	40,368	54,640
1894	Gloucester	800	174	..	944	Earl of Onslow	..	8,671	29,813	38,484
1895	Taunton	800	85	160	1055	Viscount Portman	..	13,181	30,111	43,292
1896	St. Albans	800	152	..	952	Earl of Clarendon	..	12,056	22,380	34,436
1897	Southampton	800	50	..	850	Lord Montagu of Beaulieu	..	8,284	33,750	42,034
1898	Cardiff	800	200	..	1000	Lord Windsor	..	13,101	42,501	55,602
1899	Exeter	800	..	225	1025	Lord Clinton	..	16,091	39,832	55,923
1900	Bath	800	100	150	1050	Marquis of Bath	..	11,601	36,814	49,369
1901	Croydon	800	115	..	915	(H.R.H. The Duke of Cornwall) (and York, K.G.)	1,196	9,362	30,693	41,251
1902	Plymouth	800	105	100	1041	Earl of Morley	842	12,629	40,565	54,036
1903	Bristol	800	434	50	1345	Duke of Beaufort	..	34,528	74,352	108,880
1904	Swansea	800	350	..	1150	Lord Windsor	..	28,265	50,562	78,827

ANNUAL EXHIBITIONS—continued.

Year.	Place Visited.	Local Subscription.		Prizes.			Total Local Contribution.	President.	Admissions.			Total.
		£	Local Committee.	Local Societies.	Local Residents.	£			On 5/- Day.	On 2/6 Days.	On 1/- Days.	
1905	Nottingham	800	..	218	..	£ 1018	Duke of Portland, K.G.	..	8,913	45,964	54,877	
1906	Swindon	800	..	200	50	£ 1050	Earl of Radnor	..	7,838	42,013	49,851	
1907.	Newport (Mon.)	800	201	51	29	£ 1081	H.R.H. The Prince of Wales, K.G.	..	16,236	37,819	54,055	
1908	Dorchester	800	100	25	..	£ 925	Lord Digby	..	12,227	20,350	32,577	
1909	Exeter	800	..	100	..	£ 900	Lord Clinton	..	14,898	41,891	56,789	
1910	Rochester and Chatham	800	117	..	..	£ 917	Earl of Darnley	..	5,892	20,105	25,997
1911	Cardiff	800	195	110	10	£ 1115	Marquis of Bute	..	16,213	40,588	56,801	
1912	Bath	800	100	100	..	£ 1000	Marquis of Bath	..	13,843	40,935	54,783	
1913	Truro	800	35	115	39	£ 918	Viscount Falmouth	..	12,918	44,700	57,618	
1914	Swansea	800	301	..	..	£ 1101	Sir J. T. D. Llewelyn, Bart.	..	17,957	67,805	85,762
1915	Worcester	400	..	257	..	£ 657	The Earl of Coventry	..	7,760	28,013	35,773	
1916	No Show.						The Earl of Coventry	..				
1917	ditto						The Earl of Coventry	..				
1918	ditto						The Earl of Coventry	..				
1919	ditto						The Earl of Coventry	..				

Members' Privileges.

ANALYSES OF FERTILISERS, FEEDING STUFFS, WATERS, SOILS, &c.

Applicable only to the case of Persons who are not commercially engaged in the manufacture or sale of any substance sent for Analysis).

Members of the Bath and West and Southern Counties Society, who may also be Members of other Agricultural Societies, are particularly requested in applying for Analyses, to state that they do so as Members of the first-named Society.

The following are the rates of Charges for Chemical Analyses to Members of the Society.

These privileges are applicable only when the analyses are for *bona-fide* agricultural purposes, and are required by Members of the Society for their own use and guidance in respect of farms or land in their own occupation and within the United Kingdom.

The analyses are given on the understanding that they are required for the individual and sole benefit of the Member applying for them, and must not be used for other persons, or for commercial purposes.

Land or estate agents, bailiffs, and others, when forwarding samples are required to state the names of those Members on whose behalf they apply.

Members are also allowed to send for analysis under these privileges any manures or feeding-stuffs to be used by their outgoing tenants, or which are to be given free of cost to their occupying tenants.

The analyses and reports may not be communicated to either vendor or manufacturer, except in cases of dispute.

Members are requested, when applying for an analysis, to quote the number in the subjoined schedule under which they wish it to be made.

No.		
1.	An opinion of the purity of bone-dust or oil cake (each sample)	2s. 6d.
2.	An analysis of sulphate or muriate of ammonia, or of nitrate of soda, together with an opinion as to whether it be worth the price charged	5s.
3.	An analysis of guano, showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts and ammonia, together with an opinion as to whether it be worth the price charged	10s.
4.	An analysis of mineral superphosphate of lime for soluble phosphates only, together with an opinion as to whether it be worth the price charged	5s.
5.	An analysis of superphosphate of lime, dissolved bones, &c., showing the proportions of moisture, organic matter, sand, soluble and insoluble phos; hates, sulphate of lime, and ammonia, together with an opinion as to whether it be worth the price charged	10s.
6.	An analysis of bone-dust, basic slag, or any other ordinary artificial manure, together with an opinion as to whether it be worth the price charged	10s.
7.	An analysis of compound artificial manures, animal products, refuse substances used for manure, &c. from 10s. to £1	
8.	An analysis of limestone, showing the proportion of lime	7s. 6d.
9.	An analysis of limestone, showing the proportion of lime and magnesia	10s.
10.	An analysis of limestone or marls, showing the proportion of carbonate, phosphate, and sulphate of lime and magnesia, with sand and clay	10s.
11.	Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime	£1
12.	Complete analysis of a soil	£3
13.	An analysis of oil-cake or other substance used for feeding purposes, showing the proportion of moisture, oil, mineral matter, albuminous matter, and woolly fibre as well as of starch, gum, and sugar in the aggregate; and an opinion of its feeding and fattening or milk-producing properties	10s.
14.	Analysis of any vegetable product	10s.
15.	Determination of the "hardness" of a sample of water before and after boiling	5s.
16.	Analysis of water of land-drainage, and of water used for irrigation	£1
17.	Analysis of water used for domestic purposes	£1 10s.
18.	An analysis of milk (to assist Members in the management of their Dairies and Herds, <i>bona-fide</i> for their own information and not for trade purposes, nor for use in connection with the Sale of Food and Drugs Acts)	5s.
19.	Personal consultation with the Consulting Chemist. (To prevent disappointment it is suggested that Members desiring to hold a consultation with the Consulting Chemist should write to make an appointment)	5s.
20.	Consultation by letter	5s.
21.	Consultation necessitating the writing of three or more letters	10s.

Members wishing to exercise their privileges on the above-named terms, should forward their samples for examination *by post or parcel prepaid*, to the Consulting Chemist, Dr. JOHN AUGUSTUS VOELCKER, M.A., F.I.C., Stuart House, 1, Tudor Street, London, E.C.

The fees for analysis must be sent to the Consulting Chemist at the time of application.

GUIDE TO PURCHASERS OF FERTILISERS AND FEEDING STUFFS.

Purchasers are recommended in every case to insist upon having an *Invoice* given to them. This invoice should set out clearly :—

In the case of **Fertilisers**—

- (1.) the name of the fertiliser ;
- (2.) whether the fertiliser be artificially compounded or not ;
- (3.) the analysis guaranteed in respect of the principal fertilising ingredients.

In the case of **Feeding-Stuffs**—

- (1.) the name of the article ;
- (2.) the description of the article ; whether it has been made from one substance or seed only, or from more than one
- (3.) the analysis guaranteed in respect of Oil and Albuminoids.

(NOTE.—The use of the terms “ Linseed-cake,” “ Cotton-cake,” &c., implies that these cakes shall be “ pure,” and purchasers are recommended to insist upon these terms being used without any qualification such as “ 95 per cent.,” “ as imported,” &c. “ Oil-cake ” should be avoided.

Members of the Society should see that the *Invoices* agree accurately with the orders given by them, and, in giving these orders, they should stipulate that the goods come up to the guarantees set out in the following list, and that they be sold subject to the analysis and report of the Consulting Chemist of the Bath and West and Southern Counties Society.

FERTILISERS.

Raw Bones, Bone-meal, or Bone-dust to be guaranteed “ PURE,” and to contain not less than 45 per cent. of Phosphate of Lime, and not less than 4 per cent. of Ammonia.

Steamed or “ Degelatinised ” Bones to be guaranteed “ PURE,” and to contain not less than 55 per cent. of Phosphate of Lime, and not less than 1 per cent. of Ammonia.

Mineral Superphosphate of Lime to be guaranteed to contain a certain percentage of “ Soluble Phosphate.” [From 25 to 28 per cent. of Soluble Phosphate is an ordinarily good quality.]

Dissolved Bones to be guaranteed to be “ made from raw bone and acid only,” and to be sold as containing stated percentages of Soluble Phosphate, Insoluble Phosphates, and Ammonia.

Compound Artificial Manures, Bone Manures, Bone Compounds, &c., to be sold by analysis stating the percentages of Soluble Phosphate, Insoluble Phosphates, and Ammonia contained.

Basic Slag to be guaranteed to contain a certain percentage of Phosphoric Acid, and to be sufficiently finely ground that 80 to 90 per cent. passes through a sieve having 10,000 meshes to the square inch.

Peruvian Guano to be described by that name, and to be sold by analysis stating the percentages of Phosphates and Ammonia.

Sulphate of Ammonia to be guaranteed to be “ PURE,” and to contain not less than 24 per cent. of Ammonia.

Nitrate of Soda to be guaranteed to be “ PURE,” and to contain 95 per cent. of Nitrate of Soda.

Kainit to be guaranteed to contain 23 per cent. of Sulphate of Potash.

All fertilisers to be delivered in good and suitable condition for sowing.

FEEDING-STUFFS.

Linseed Cake, Cotton Cake (Decorticated and Undecorticated), and **Rape Cake** (for feeding purposes) to be pure, i.e., prepared *only* from one kind of seed from which their name is derived, and to be in sound condition. The report of the Consulting Chemist of the Bath and West and Southern Counties Society to be conclusive as to the "purity" or otherwise of any feeding-stuffs. The percentages of Oil and Albuminoids must also be guaranteed.

Mixed Feeding Cakes, Meals, &c., to be sold on a guaranteed analysis.

All Feeding-Stuffs to be sold in sound condition, and to contain nothing of an injurious nature or worthless for feeding purposes.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

GENERAL RULES.

1.—A sample taken for analysis should be fairly *representative of the bulk* from which it has been drawn.

2.—The sample should reach the Analyst in the *same condition* as it was at the time when drawn.

FERTILISERS.

When **Fertilisers** are delivered in bags, select four or five of these from the bulk, and either turn them out on a floor and rapidly mix their contents, or else drive a shovel into each bag and draw out from as near the centre as possible a couple of shovelfuls of the manure, and mix these quickly on a floor.

Halve the heap obtained in either of these ways, take one-half (rejecting the other) and mix again rapidly, flattening down with the shovel any lumps that appear. Repeat this operation until at last only some three or four pounds are left.

From this fill three tins, holding from $\frac{1}{2}$ lb. to 1 lb. each, mark, fasten up and seal each of these. Send one for analysis, and retain the others for reference.

Or,—the manure may be put into glass bottles provided with well-fitting corks; the bottles should be labelled and the corks sealed down. The sample sent for analysis can be packed in a wooden box and sent by post or rail.

When manures are delivered in bulk, portions should be successively drawn from *different parts* of the bulk, the heap being turned over now and again. The portions drawn should be thoroughly mixed, sub-divided, and, finally, samples should be taken as before, except that when the manure is coarse and bulky it is advisable to send larger samples than when it is in a finely-divided condition.

FEEDING-STUFFS.

Linseed, Cotton, and other Feeding Cakes.—If a single cake be taken three strips should be broken off right across the cake and from the middle portion of it, one piece to be sent for analysis, and the other two retained for reference. Each of the three pieces should be marked, wrapped in paper, fastened up and sealed. The piece forwarded for analysis can be sent by post or rail.

A more satisfactory plan is to select four to six cakes from different parts of the delivery, then break off a piece about four inches wide from the middle of each cake, and pass these pieces through a cake-breaker. The broken cake should then be well mixed, and three samples of about 1 lb. each should be taken and put in tins or bags duly marked, fastened, and sealed as before. One of these lots

should be sent for analysis, the remaining two being kept for reference. It is advisable, also, with the broken pieces, to send a small strip from an unbroken cake.

Feeding Meals, Grain, &c.—Handfuls should be drawn from the centre of half-a-dozen different bags of the delivery: these lots should then be well mixed, and three $\frac{1}{2}$ lb. tins or bags filled from the heap, each being marked, fastened up, and sealed. One sample is to be forwarded for analysis and the others retained for reference.

SOILS, WATERS, &c.

Soils.—Have a wooden box made, 6 inches in length and width, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil and its subsoil 9 to 12 inches deep; trim this block to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up gently, turn over the box, nail on the lid, and send by rail. The soil will then be received in the position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

Waters.—Samples of water are best sent in glass-stoppered Winchester bottles holding half a gallon. One such bottle is sufficient for a single sample. Care should be taken to have these scrupulously clean. In taking a sample of water for analysis it is advisable to reject the first portion drawn or pumped, so as to obtain a sample of the water when in ordinary flow. The bottle should be rinsed out with the water that is to be analysed, and it should be filled nearly to the top. The stopper should be secured with string, or be tied over with linen or soft leather. The sample can then be sent carefully packed either in a wooden box with sawdust, &c., or in a hamper with straw.

Milk.—A pint bottle should be sent in a wooden box.

GENERAL INSTRUCTIONS.

Time for Taking Samples.—All samples, both of fertilisers and feeding-stuffs, should be taken as soon after their delivery as possible, and should reach the Analyst within *ten days* after delivery of the article. In every case it is advisable that the Analyst's certificate be received before a fertiliser is sown or a feeding-stuff is given to stock.

Procedure in the event of the Vendor wishing Fresh Samples to be Drawn.—Should a purchaser find that the Analyst's certificate shows a fertiliser or feeding-stuff not to come up to the guarantee given him, he may inform the vendor of the result and complain accordingly. He should then send to the vendor *one* of the two samples which he has kept for reference. If, however, the vendor should demand that a fresh sample be drawn, the purchaser must allow this, and also give the vendor an opportunity of being present, either in person or through a representative whom he may appoint. In that case, three samples should be taken in the presence of both parties with the same precautions as before described, *each* of which should be duly packed up, labelled and sealed by both parties. One of these is to be given to the vendor, one is to be sent to the Analyst, and the third is to be kept by the purchaser for reference or future analysis if necessary.

All samples intended for the Consulting Chemist of the Society should be addressed (postage or carriage prepaid) to Dr. J. AUGUSTUS VOELCKER, M.A., F.I.C., Stuart House, 1, Tudor Street, New Bridge Street, London, E.C. Separate letters of instruction should be sent at the same time.

FINANCIAL STATEMENTS

FOR

1918

WITH ITEMS OF 1917 FOR COMPARISON.

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DETAILED CASH ACCOUNT	xx xxiii
ASSETS AND LIABILITIES xxiv

The Bath and West and
Dr. CASH ACCOUNT FOR THE YEAR ENDING DEC. 31st,

RECEIPTS.	1918.		1917.
	£	s. d.	£ s. d.
DIVIDENDS AND INTEREST:—			
War Loan Stock	208	15 11	200 5 4
South Australian Stock	30	1 1	31 1 10
New Zealand Stock	39	15 9	41 3 2
India Stock	163	19 4	169 12 4
Queensland Stock	64	7 3	82 10 10
New South Wales Stock	50	16 5	52 11 6
Canadian Pacific Stock	48	18 9	47 16 3
	606	14 6	625 1 3
Income Tax returned	142	10 2	184 11 8
		749 4 8	809 12 11
GENERAL RECEIPTS:—			
Telephone Way Leave	0	1 0	0 1 0
Waste Paper	2	8 9	
		2 9 9	0 1 0
SUBSCRIPTIONS FROM MEMBERS:—			
Arrears	17	13 0	24 13 0
Governors	136	17 0	138 17 0
Subscribers of £1 and upwards	577	0 6	610 0 0
Ditto of 10s.	7	10 0	7 0 0
		739 0 6	780 10 0
LIFE COMPOSITIONS			5 0 0
JOURNAL:—]			
Sales	4	18 11	5 0 0
Advertisements	38	18 2	34 12 0
		43 17 1	39 12 0
Carried forward	£	1,534 12 0	

Southern Counties Society.**1918, WITH COMPARATIVE STATEMENT FOR 1917.****Cr.**

PAYMENTS.	1918.			1917.		
	£	s.	d.	£	s.	d.
SALARIES :—						
Secretary (including Clerks, &c.)	1,050	0	0	1,050	0	0
Auditor	20	0	0	20	0	0
Consulting Chemist	30	0	0	30	0	0
	1,100 0 0			1,100 0 0		
MISCELLANEOUS :—						
Printing	10	13	2	9	18	5
Stationery and Finance Books	9	18	9	14	8	8
Postages, Telegrams, Cheque and Receipt Stamps	18	19	10	12	18	4
Ground Rent and Rates	22	8	10	20	12	5
Property Tax	9	7	6	9	7	6
Travelling Expenses	15	17	7	16	3	10
Carriage of Goods	1	0	1	0	18	6
Directories and Reference Books	1	0	5	0	14	6
Subscriptions	6	11	0	6	11	0
Repairs and Fittings	2	5	7	3	4	8
Fuel and Light	1	19	4	6	13	6
Finance Committee's Expenses	3	11	3	3	6	0
Telephone	7	16	0	7	16	0
Grants for Instruction in Milking	25	1	3	20	0	0
Bank Charges				8	4	11
	136 10 7			140 16 3		
JOURNAL :—						
Editor	100	0	0	100	0	0
Associate Editor	100	0	0	100	0	0
Printing and Binding	155	13	10	156	1	0
Plans and Blocks	9	11	10	21	14	6
Journal Distribution	21	6	4	18	19	11
Postages, Stationery, Reference Books, &c.	2	18	8	2	18	8
Payments to Authors	33	14	0	53	9	0
	423 2 8			463 0 11		
Carried forward	£ 1,550 13 3					

CASH ACCOUNT—continued

	1918.			1917.		
	£	s.	d.	£	s.	d.
Brought forward . . .				1,534	12	0
Sale of Queensland Stock . . .				1,534	12	0
Balance due to Bank, Dec. 31st. . .				90	8	2
	£	2,565	0 2	2,253	2	10

CASH ACCOUNT—continued.

Cr.

PAYMENTS.	1918.			1917.		
	£	s.	d.	£	s.	d.
Brought forward				1,6	9	13 3
SHOW :—						
Unapportionable :—						
Superintendent of Works	150	0	0			150 0 0
Insurance of Plant	1	15	0			1 15 0
Rent of Stores	5	5	0			7 17 6
				157	0	0
EXPERIMENTS :—						
Elder Institute				100	0	0
				1,916	13	3
INVESTMENTS				30	0	0
Balance due to Bank, Jan. 1st	618	6	11	269	13	2
	£	2,563	0 2	2,253	2	10

Jan. 11th, 1919.

I hereby certify that I have examined the foregoing accounts for the year ending December 31st, 1918, compared the payments entered with the vouchers, and found them all in order and correct.

F. CLIFFORD GOODMAN, F.C.A.,

Auditor.

Passed by Council,

Jan. 28th, 1919,

THOS. F. FLOWMAN,

Secretary.

Bath and West and Southern Counties Society,
 FOR THE
Encouragement of Agriculture, Arts, Manufactures and Commerce.

List of Members, 1919.

PATRON.

HIS MOST GRACIOUS MAJESTY THE KING.

PRESIDENT.

THE RIGHT HON. THE EARL OF COVENTRY.

TRUSTEES.

THE MOST HON. THE MARQUIS OF BATH. K.G.
 C. L. F. EDWARDS, Esq.

Names thus () distinguished are Governors.*

Names thus (†) distinguished are Life Members.

.. Members are particularly requested to make the Secretary acquainted with any errors in the names of residences.

Name.	Residence.	Sub- scriptions		
		£	s.	d.
*†His Most Gracious Majesty the King	Windsor Castle	..	..	..
Ackers, Major Chas. F.	Huntley Manor, Gloucester	1	0	0
Ackland, J.	Cutton Farm, Poltimore, Exeter	1	0	0
Acland, Alfred Dyke		1	0	0
†Acland, Rt. Hon. A. H. Dyke	29, St. James' Court, Buckingham Gate, London, S.W.1	..	..	..
Acland, Right Hon. F. Dyke, M.P.	93, Bedford Gardens, Campden hill, London, W.	1	0	0
Adams, E. C.	Brentwood, Combe Down, Bath	1	0	0
Adeane, C. R. W.	Babraham, Cambridge	1	0	0
†Aitken, G. H.	Longleat Estate Office, Warminster	..	..	..
Akers, E.	St. Fagans, Cardiff	1	0	0
Alexander, D.	Cardiff	1	1	0
Alexander, H. G.	Dinas Powis, Cardiff	1	1	0
Allen & Sons	Cheese Merchants, Shepton Mallet	1	1	0
†Allen, James D.	Springfield House, Shepton Mallet	..	..	..

Name.	Residence.	Subscriptions.		
		£	s.	d.
Allen, W. T.	Bradley House, West Pennard, Bridgwater	1	0	0
Allix, C. I. L.	St. Germans, Cornwall	1	0	0
Allsebrook, A.	Link Elm, Malvern Link	1	1	0
Ames, F.	Hawford Lodge, Worcester	1	0	0
Andrews, S. Fox-	Union Street, Bath	1	0	0
Anglo-Continental Guano Works	Dock House, Billiter Street, E.C.3.	1	0	0
Anglo-Swiss Condensed Milk Company	Chippenham	1	0	0
Arnott, G. C. (Fertilisers Manufacturers Association)	69, Fenchurch Street, London, E.C.3	1	0	0
†Ashcomb, Lord	Denbies, Dorking	..	..	..
†Ashcroft, W.	13, The Waldrons, Croydon	..	..	..
Ashford, E. C., M.D.	The Moorlands, Bath	1	0	0
*Astor, Hon. Waldorf	Cliveden, Taplow, Bucks	2	0	0
Augustein, J. R.	Holbrook House, Wincanton	1	0	0
Aungier, J.	Lynwick, Rudgwick	1	0	0
†Avebury, Lord	High Elms, Hayes, Kent	..	..	..
†Aveling, Thomas L.	Rochester	..	..	..
Avon Manure Company (Ld.)	St. Philip's Marsh, Bristol	1	0	0
Badcock, H. Jefferies	Broadlands, Taunton	1	0	0
Bainbridge, Mrs. R. C.	Elfordleigh, Plympton, South Devon	1	0	0
Baker, G. E. Lloyd	Hardwicke Court, Gloucester	1	0	0
†Baker, M. G. Lloyd	The Cottage, Hardwicke, Glos.	..	..	..
†Baker, L. J.	10, Ennismore Gardens, London, S.W.7	..	..	..
*Balston, W. E.	Barvin, Potters Bar, Herts	2	0	0
Bamfords (Ltd.)	Uttoxeter	1	1	0
Barford and Perkins (Ltd.)	Peterborough	1	0	0
Barham, G. T.	Sudbury Park, Wembley, Middlesex	1	0	0
Baring, Hon. A. H.	The Grange, Alresford, Hants	1	0	0
*Barker-Hahlo, H.	Camerton Court, Bath	2	0	0
Barlow, Sir J. Emmott, Bart.	Torkington Lodge, Hazel Grove, near Stockport	1	0	0
Barrett, Col. W.	Hill House, Minehead	1	0	0
Barstow, J. J. J.	The Lodge, Weston-super-Mare	1	1	0
Barton, D. J.	Penbertha, Marazion, Cornwall	0	10	0
Bassett, A. F.	Tehidy, Camborne, Cornwall	1	0	0
Bates, W. J. & Co.	Victoria Iron Works, Denton, Man- chester	1	0	0
*†Bath, Marquis of, K.G.	Longleat, Warminster	..	..	..
Bath and Somersetshire Dairy Co. (Ltd.)	Bath	1	0	0
Bath and Wells, The Bishop of	The Palace, Wells	1	1	0

Name.	Residence.	Subscriptions.
		£ s. d.
Bath Gas Company	Bath	1 0 0
Batt, R.	Clapton, Ston Easton, Bath	1 0 0
Batten, Col. Cary	Abbotsleigh, Bristol	1 0 0
Batten-Pooll, R. H.	Road Manor, Bath	1 0 0
†Baxendale, J. Noel	Froxfield Green, Petersfield . . . . .	..
Beauchamp, E. B.	Trevince, Redruth	1 0 0
Beauchamp, Sir F. B.	Woodborough House, Peasedown St. John, Bath	1 1 0
*Beaufort, Duke of	Badminton, Chippenham	2 2 0
Beaufoy, M. H.	Coombe Priory, Shaftesbury	1 0 0
Bennett, Brothers	Journal Office, Salisbury	1 1 0
Bennett, R. A.	Thornbury, Glos.	1 0 0
Bennetts, J. M.	Killaganoon, St. Feock, Cornwall	1 1 0
Bentall, Edward H. & Co.	Heybridge, Maldon, Essex	1 0 0
Benyon, H. A.	Englefield House, Reading	1 1 0
*Benyon, J. Herbert	Englefield House, Reading	5 0 0
Berryman, F. H.	Field House, Shepton Mallet	1 1 0
Best, Major T. G.	East Carleton Manor, Norwich	1 0 0
†Best, Capt. W.	Vivod, Llangollen, North Wales . . . . .	..
Best, Hon. Bertha	Charlton House, Ludwell, Salis- bury	1 0 0
Best, Hon. J. W.	Charlton House, Ludwell, Salisbury	1 0 0
Beynon, J. W.	16, Mount Stuart Square, Cardiff	1 1 0
Birmingham, C.	Nutscale, The Parks, Minehead	0 10 0
†Blackburn, H. P.	Donhead Hall, Salisbury . . . . .	..
†Blackstone, G. M.	Blackstone & Co., Ltd., Stamford . . . . .	..
Blake, Col. M. Lock	Bridge, S. Petherton	1 0 0
Blathwayt, R. W.	Dyrham Park, Chippenham	1 1 0
†Bledisloe, Lord	Lydney Park, Glos. . . . .	..
Bolden, Rev. C.	Preston Bissett, Buckingham	1 0 0
Bolitho, R. F.	Ponsandane, Penzance	1 1 0
Bolitho, T. R.	Trengwainton, Hea Moor, Cornwall	1 1 0
Bond E. (W. Evans & Co.).	Hele, Cullompton	1 0 0
Boscawen, Rev. A. T.	Ludgvan Rectory, Long Rock, R.S.O., Cornwall	1 0 0
Boscawen, Townshend E.	2, Old Burlington St., London, W.1.	1 0 0
Bourne, W. W.	Garston Manor, Watford, Herts	1 0 0
Bouverie, H. P.	Brymore, Bridgwater	1 0 0
†Bowen-Jones, Sir J., Bart.	The Woodlands, Bicton, near Shrewsbury . . . . .	..
†Bowerman, Alfred	Hewelsfield Court, St. Briavels, Glos. . . . .	..
Boyle, Major M.	The Manor, Staple Fitzpaine, Taunton	1 0 0
Braby, F. & Co.	Ashton Gate Works, Bristol	1 0 0
Bradford, Thomas & Co.	Salford, Manchester	1 0 0
*†Brassey, H. L. C.	Apethorpe Hall, Wansford, Northants . . . . .	..

Name.	Residence.	Subscriptions.
		£ s. d.
Bridges, J. H.	Ewell Court, near Epsom	1 1 0
†Brinkley, Rev. W. F. B.	The Vicarage, Abbots Leigh, Bristol	..
<i>Bristol Times and Mirror</i> , Proprietors of	Bristol	1 0 0
Bristol Wagon and Carriage Works Co. (Ltd.)	Lawrence Hill, Bristol	1 1 0
Britten, Forester	Kenswick Manor, Worcester	1 0 0
†Broadmead, W. B.	Enmore Park, Bridgwater	..
†Brocklehurst, H. D.	Sudeley Castle, Winchcombe	..
Brockman, F. D.		1 0 0
Broderip, E.	Cossington, Somerset	1 0 0
Brown, F. E.	1,403 Neath Road, Swansea	1 0 0
Browning, Albert, M.A.	The Homestead, Combe Park, Bath	1 1 0
†Buckingham, Rev. Preb.	The Rectory, Doddiscombsleigh, Exeter, Devon	..
Buck, D.	White House, Little Mill, Pontypool	1 0 0
Budd, Felix S.	Clarendon House, Stow Park, New- port, Mon.	1 0 0
Budd, J. E.	Tidebrook Manor, Wadhurst, Sussex	1 0 0
Burghclere, Lord	48, Charles Street, London, W.	1 0 0
Burnard, R.	Cattedown, Plymouth	1 0 0
Burrell, C. and Sons	St. Nicholas Works, Thetford	1 0 0
*Burrell, Sir M. R., Bart.	Knepp Castle, Horsham, Sussex	2 0 0
†Bush, H. G.	The Grove, Alveston, Glos.	..
Bush, Mrs L. E.	St. Mary's, Atlantic Road South, Weston-s-Mare	1 1 0
*Bute, The Marquis of	The Castle, Cardiff	2 0 0
Butland, B.	Leigham, Plympton	1 0 0
Cæsar, H. and J.	Knutsford, Cheshire	1 0 0
Campbell, J.	93, Mansel Street, Swansea	1 0 0
Candy, T. C.	Woolcombe, Cattistock, Dorset	1 0 0
Carew, C.	Collipriest, Tiverton	1 0 0
Carnarvon, Earl of	Highclere Castle, Newbury	1 1 0
*Carr, Jonathan	Wood House, Twerton-on-Avon, Bath	2 2 0
†Carruthers W., F.R.S	14, Vermont Road, Norwood, London, S.E.	..
Carson, J.	Crystalbrook, Theydon Bois, Essex	1 0 0
†Carter, E.	East Upton, Ryde, Isle of Wight	..
Carter, G. V.	Waterston Manor, Dorchester	1 1 0
Carter, Dunnett & Beale	Raynes Park, London, S.W.	1 0 0
Cartwright, T. G.	30, Beaufort Gardens, London, S.W.	1 0 0
Carver, H. R.	West House, Chilton Polden, Bridgwater	1 0 0
Cary, Edmund	Pylle, Shepton Mallet	0 10 0
†Cary, John	The Priory, Shepton Mallet	..

Name.	Residence.	Subscriptions.		
		£	s.	d.
†Cary, W. H.	Mantua, Steeple Ashton, Trowbridge			..
Cattybrook Brick Co. (Ltd.)	Provident Buildings, 15, Clare Street, Bristol	1	0	0
Cave, Sir C., Bart.	Lidbury Manor, Sidmouth	1	0	0
Cave, C. H.	Rodway Hill House, Mangotsfield, Bristol	1	0	0
Cazalet, W. M.	Fairlawne, Tonbridge	1	0	0
Chapman, W. W.	Mowbray House, Norfolk Street, Strand, London, W.C.2	1	1	0
Chichester, Major C. H.	Hall, Bishops Tawton, Barnstaple	1	0	0
†Chick, J. H.	Wynford Eagle, Maiden Newton, Dorset			..
†Chick, W. D.	Compton Valence, Dorchester			..
Childs, C., M.D.	Boscarn, Looe, R.S.O., Cornwall	1	0	0
Christie, A. L.	Tapeley Park, Instow, N. Devon	1	1	0
Churchill, The Viscount, G.C.V.O.	Carlton Club, Pall Mall, London, S.W.1.	1	0	0
†Churchward, F.	Hill House, Stoke Gabriel, near Totnes			..
*Clarendon, Earl of	The Grove, Watford	2	2	0
Clark, H. A.	Hinton Field, Hinton Charterhouse, Bath	1	0	0
†Clark, J. J.	Goldstone Farm, Hove, Sussex (Hon. Local Sec., 1885)			..
Clark, W. S.	Street, Glastonbury	1	0	0
Clark, W. H.	Rutland Cottage, Combe Down, Bath	1	1	0
Clarke, J. B.	Overleigh House, Street, Somerset	1	0	0
Clerk, Lieut.-Col. R. M.	Charlton House, Shepton Mallet	1	0	0
*Clifden, Viscount	Lanhydroc, Bodmin	2	0	0
Clinton, Lord	Heanton Satchville, Dolton, N. Devon	1	0	0
Clutton, R. W.	Hartwood, Reigate	1	0	0
Coaker, J.	Blagdon Barton, Paignton, Devon	0	10	0
Cobb, H. M.	Higham, Rochester	1	0	0
Cobb, R.	Larkin Hall, near Rochester	1	0	0
Coleridge, Hon. G.	Toddington, Winchcombe	1	0	0
Collet, Sir Mark, Bart.	St. Clare Kemsing Sevenoaks	1	1	0
Collins, J. J. S.	St. George's Lodge, Oldfield Park, Bath	1	1	0
Colman, Sir J., Bart.	Gatton Park, Surrey	1	0	0
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Colville, H. K.	Hillmarton Lodge, Calne, Wilts	1	0	0
Connolly, Hon. J. D.	Agent-General for Western Australia, Savoy House, Strand, London, W.C.2	1	1	0

Name.	Residence.	Subscriptions.		
		£	s.	d.
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†Cookson, H. T.	Sturford Mead, Warminster		
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Cope, W.	Southerndown, Glam.	1	1	0
Corbet, E. W. M.	Bute Estate Office, Cardiff	1	1	0
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†Corner, H. W.	Manor House, Inglescombe, Bath		
†Cornwallis, F. S. W.	Linton Park, Maidstone		
Cory, Sir Clifford, Bart., M.P., D.L.	Llantarnam Abbey, Mon.	1	0	0
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Coultas, J. R.	Allington, near Grantham	1	0	0
Coultrip, A. W.	Norwood Manor, East Church, Kent	1	0	0
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Crowdson, J. D.	Syde, near Cheltenham	1	0	0
Crick, Thomas	Alcombe, Cross Road, Minehead	0	10	0
Cridlan, J. J.	Maisemore Park, Gloucester	1	0	0
Crutchley, P. E.	Limminghill Lodge, Ascot	1	0	0
Cuming, A. P.	Moreton Hampstead, Devon	1	0	0
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Daniel, Thos. C.	Stuckeridge, Bampton, North Devon	1	1	0
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Name.	Residence.	Subscriptions.		
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Demuth, R. H.	1	0	0
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†Devas, H. G.	Hartfield, Hayes, Kent
*Devon, The Earl of . . .	Powderham Castle, Devon . . .	2	0	0
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Dodington, R. M.	Horsington Park, Templecombe . . .	1	1	0
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Name.	Residence.	Subscriptions.
		£ s. d.
*†Eastwood, J. E.	Gosden House, Bramley, Guildford	..
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†Edmondson, A.	Woodlose, Silverdale, Lancashire	..
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Name.	Residence.	Subscriptions.
		£ s. d.
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†Gladstone, J.	Bowden Park, Chippenham	..
Glyn, Sir R. F., Bart	The Cross House, Fontmell Magna, Shaftesbury	1 0 0
†Godman, C. B.	Woldringfold, Horsham	..
Godman, J.	The Raswells, Hascombe, Godalming	1 0 0
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Gomer, W.	Killerton Estate Office, Broad- clyst, Exeter	1 0 0

Name.	Residence.	Subscriptions.		
		£	s.	d.
Goodden, J. R. P.	Compton House, Sherborne	1	0	0
Goodman, A. & Co.	3, Hammett Street, Taunton, and Broad Street House, London, E.C.	1	0	0
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Goring, C.	Wiston Park, Steyning	1	0	0
†Gorringe, Hugh	Kingston-by-Sea, Brighton	..		
Grace, A.	39, Welsh Back, Bristol	1	0	0
Grant, C. E.	Bursar, King's College, Cambridge.	1	0	0
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Greaves, R. M.	Wern, Portmadoc, North Wales	1	0	0
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Greenway, W.	Halse, Taunton	1	0	0
Greenwell, Sir W., Bart.	Marden Park, Woldingham, Surrey	1	0	0
Greenwood, J. C.	Claverton Down, Bath	1	0	0
Gregor, T.	11, Sketty Road, Swansea	1	0	0
Gregory, W.	Wellington, Somerset	1	0	0
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Gunther, C. E.	Tongswood, Hawkhurst, Kent	1	0	0
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Hall, A. C.	The Manor, Great Rolbright, Chipping Norton	1	0	0
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†Hambro, Sir Everard A.	Hayes Place, Beckenham, Kent	..		
Hancock, Rev. Prebendary F.	The Priory, Dunster, Somerset	1	0	0
Hancock, H. C.	The Court, Milverton, Taunton	1	0	0
Hancock, Mrs. R. D.	Halse, Taunton	1	0	0
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Harding, C.	Upton Grove, Tetbury	1	0	0
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Harris, J. M.	Chilvester Lodge, Calne, Wilts	1	0	0
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Harrison, McGregor & Co.	Leigh, Lancashire	1	0	0
Haward, T. W.	Manor End, Berkhamsted, Herts	1	1	0
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Name.	Residence.	Subscriptions.		
		£	s.	d.
†Henderson, A. N.	Street Ashton House, Lutterworth	..		
Heneage, Capt. R.N.	Pare le Breos, Penmaen, Glam. . .	1	0	0
Henry, Lt.-Col. F.	Elmtree, Tetbury	1	0	0
Heppel, E. M.	Camerton, near Bath	1	0	0
Hesse, F. W.	Bloomfield House, Bloomfield Road, Bath	1	0	0
†Hewitt, G. Southby.	Day, Son & Hewitt, 22, Dorset Street, London, W.1		
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†Hill, B. H.	Uphill, Weston-super-Mare		
Hill, H.	Paulton, near Bristol	1	1	0
Hill, Major V. T.	Mendip Lodge, Langford, Bristol . .	1	1	0
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*Hobhouse, Rt. Hon. H.	Hadspen House, Castle Cary.	2	0	0
†Hoddinott, S.	Worminster, Shepton Mallet		
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Holt Needham, O. N.	Barton Court, Colwall, near Malvern	1	0	0
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Horton-Starkie, Rev. Preb. Le G. G.	Wellow Vicarage, Bath	1	1	0
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Hosegood, Obed., jun.	Dillington, Ilminster	0	10	0
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Hoskyns, H. W. P.	North Perrott Manor, Crewkerne, Somerset	1	0	0
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Name.	Residence.	Subscriptions.		
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Jarmain, T. M.	Haseley Iron Works, Tetsworth . .	1	1	0
Jenkins, D.	Flemington Court, Cowbridge, Glam.	1	0	0
Jenkins, E.	c/o F. Capern, Lewin's Mead, Bristol	1	0	0
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Jervoise, F. H. T.	Herriard Park, Basingstoke	1	1	0
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King, W. E. M.	Donhead Lodge, Salisbury	1	0	0
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Name.	Residence.	Sub-
		scriptions.
		£ s. d.
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Lawes, Algernon (Ltd.)	203, Hornsey Road, London, N.7	1 1 0
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Lennard, Sir H., Bart.	Wickham Court, West Wickham, Kent	1 0 0
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Lipscomb, Godfrey	Margam Park, Port Talbot	1 0 0
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†Lister, J. J.	Warninglid Grange, Haywards Heath
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Long, Col. William	Woodlands, Congresbury, Somerset	1 0 0
Long, W. F.	New Barnes Farm, Bromyard	1 0 0
Longrigg, G. E.	Weston Lea, Bath	1 0 0
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Loram, Brothers	Cathedral Dairy, Exeter	1 1 0
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Lubbock, Major G.	Greenhill, Warminster, Wilts	1 0 0
†Lutley, J. H.	Brockampton, Worcester
Luttrell, Capt. A. F.	Court House, East Quantoxhead, Bridgwater	1 0 0
Luttrell, Claude M. F.	Benmead, Box, Wilts	1 1 0

Name.	Residence.	Subscriptions.		
		£	s.	d.
MacGregor, Brigadier-General, W.	Claverton Rectory, Bath	1	0	0
Macdonald, H. L. S.	Avondale, Bathford, Bath	1	0	0
Major, H. J. and C. (Ltd.)	Bridgwater	1	0	0
†Mansell, A. E.	Mount Vernon, Melton Mowbray, Tasmania			
Marcus, M.	High Trees, Redhill, Surrey	1	0	0
Marfell, R. H.	Great House Farm, Llangeview, Usk	1	0	0
Marshall, L. H.	Chippenham	1	0	0
Marshall, Sons & Co. (Ltd.)	Britannia Iron Works, Gainsborough	1	0	0
Martin, E. G. Bromley	Ham Court, Upton-on-Severn	1	0	0
Martin, J.	Thorverton, R.S.O., Devon	1	0	0
Martin, L. J. (Associated Manufacturers' Assn.)	72-80, Mansell Street, Aldgate, London, E.1	1	0	0
Martin and Carnes	Taunton	1	1	0
Martyn, G.	Tremeddan, Liskeard, Cornwall	1	1	0
Mason, F. F.	Swansea	1	0	0
Massey-Harris Co. (Ltd.), (C. W. Dawkins, General Manager)	54 & 55, Bunhill Row, London, E.C.1	1	0	0
Masters, A.	Kyneton, Thornbury, Glos.	1	0	0
Mathews, Ernest	Little Shardeloes, Amersham, Bucks	1	0	0
Mathews, E. R. Norris, F.R.Hist. Soc.	Central Library, Bristol	1	0	0
Maule, Major-Gen. H. B.	2, Penn Lea Road, Newbridge Hill, Bath	1	0	0
Meager, F. F.	Melbourne House, Swansea	1	0	0
Meddick, William G.	11, Great Stanhope Street, Bath	1	0	0
Membery, R.	37, Southgate Street, Bath	1	0	0
Merry, Richard	Goulds, Broadclyst, Exeter	0	10	0
Methuen, General Lord; C.B., C.M.G.	Corsham Court, Wilts	1	0	0
Mildmay, Capt. C. B. St. J.	Hallam, Dulverton	1	0	0
†Mildred, G. B.				
Millbank, Sir Powlett C. J., Bart.	Norton Manor, Presteign	1	0	0
Miller-Hallett, A.	Goddington, Chelsfield, Kent	1	1	0
Mills, B. W.	31, Cambridge Place, Paddington, London, W.	1	0	0
Mitchell, Mrs. C. L.	Highgrove, Tetbury	1	0	0
Molassine Co. (Ltd.)	East Greenwich, London, S.E.	1	0	0
Moody, C.	Maisemoor, Evercreech	1	0	0
Moore-Gwyn, J. E.	Duffryn, Neath, Glamorgan	1	0	0

Name.	Residence.	Subscriptions.		
		£	s.	d.
†Moore, H. F.	Renée House, 48, Dulwich Road, Herne Hill, S.E.24	..	..	..
Moore-Stevens, Col. R. A.	Winscott, Torrington, Devon	1	0	0
Morant, Lady, K. F.	Brokenhurst Park, Hants	1	0	0
Morel, C. E.		1	0	0
*Moreton, Lord	Sarsden Lodge, Chipping Norton	2	2	0
*Morley, Earl of	Saltram, Plympton, Devon	2	0	0
*Morris, C.	Highfield Hall, St. Albans	2	0	0
Morris and Griffin (Ltd.)	Maindee, Newport, Mon.	1	1	0
Morris, Sir R. A., Bart.	Sketty Park, Swansea	1	0	0
Morris, Son and Peard	Auctioneers, North Curry, Taunton	1	0	0
Morrison, Major J. A., D.S.O.	Berwick House, Hindon, Salisbury	1	0	0
†Morrison, J. A.	Basildon Park, Reading	..	..	..
Mount-Edgecumbe, Earl of	Mount Edgecumbe, Devonport	1	1	0
†Mucklow, E., J.P.	Woodhill, Bury, Lancashire	..	..	..
Munn, F.	Dumballs Road, Cardiff	1	0	0
Muntz, F. E.	Umberslade, Hockley Heath, War- wickshire	1	0	0
Muntz, Capt. J. O.	Foxhams, Horrabridge, S. Devon	1	0	0
Murray-Anderdon, H. Edwd.	Henlade House, Taunton	1	1	0
Napier, H. B.	Ashton Court Estate Office, Long Ashton, Bristol	1	1	0
Neagle, D. T.	London, Gloucester and N. Hants Drug Co. (Ld.), 25, Whatley Road, Clifton, Bristol	1	0	0
Neal, J. F.	Kingsdon, Taunton	1	0	0
Neeld, Sir A. D., Bart., C.B.	Grittleton, Chippenham	1	0	0
Nelder, C. W.	Carnarvon Arms, Dulverton, Somerset	0	10	0
†Neville-Grenville, Robert	Butleigh Court, Glastonbury	..	..	..
New, H. G.	Craddock, Cullompton, Devon	1	0	0
Newington, C.	Oakover, Ticehurst, Sussex	1	0	0
Newman, Sir R. H. S., Bart. M.P., D.L.	Mamhead Park, near Exeter	1	1	0
Nicholetts, E. C.	The Lons, Bitton, Gloucestershire	1	0	0
Nichols, G.	49, Broad Street, Bristol	1	0	0
Nitrogen Fertilisers (Ltd.)	Winchester House, Old Bond Street, London, E.C.2	1	0	0
Nix, J. A.	Tilgate, Crawley, Sussex	1	1	0
Nixon, W.	The University, Bristol	1	0	0
*Normanton, Earl of	Somerley, Ringwood	2	0	0
North, G. F.	Stratfield Saye, Mortimer, R.S.O., Berks.	1	0	0
*Northumberland, Duke of	Albury Park, Guildford	2	0	0

Name.	Residence.	Subscriptions.		
		£	s.	d.
Oakey, G.	Brittleware Farm, Charlwood, Surrey	1	0	0
†O'Hagan, Lord	Pyrgo Park, Havering Atte Bower, Romford, Essex . . . . .	..	
O'Halloran, Miss P. . . .	Fairwood Lodge, Killay, R.S.O., Glam.	1	0	0
Osmond and Son	Grimsby	1	0	0
Paget, A. B.	Bathwick Estate Office, 100, Sydney Place, Bath.	1	0	0
Paget, L. C.	Middlethorpe Hall, Yorks	1	0	0
*Paget, Sir Richard, Bart. . .	9, King's Bench Walk, Temple, London	2	0	0
Palmer, Brigadier-General, G. Ll., M.P.	Lackham, Lacock, Wilts	1	0	0
†Palmer, R.	Lodge Farm, Nazeing, Waltham Cross, Essex . . . . .	..	
Palmer, W. H.	York Buildings, Bridgwater	1	0	0
†Parker, Hon. Cecil T. . . .	The Grove, Corsham, Wilts . . . .	..	
Parker, F. J.	Plymouth Street, Swansea	1	0	0
Parmiter, P. J. & Sons . . .	Tisbury, Wilts	1	0	0
Parry-Okeden, Lieut.-Col. U. E. F.	Turnworth, Blandford	1	0	0
†Parsons, J. D. Toogood . . .	Grasmere, East Hoathley, Sussex . .	..	
†Parsons, R. M. P.	Misterton, Crewkerne . . . . .	..	
Pass, A. D.	Manor House, Wootton, Fitzpaine, Charmouth, Dorset	1	0	0
Peacock, W.	3, Buckingham Gate, London . . .	1	1	0
Pearce, S. & Co.	46a, Market Street, Manchester . .	1	0	0
Pearse, T. C.	Leigh Farm, Dulverton	1	0	0
Peel, Viscount	52, Grosvenor Street, London, W. .	1	1	0
Pember, G. H. . . . .	. . . . .	1	0	0
Penberthy, Professor J. . . .	Dean Hall, Newnham, Glos. . . .	1	0	0
Pendarves, W. Cole	Pendarves, Camborne, Cornwall . .	1	1	0
Pennefather, de F., M.P. . .	Kinnersley Castle, Hereford . . .	1	0	0
Pepper, W. F.	Redlynch Park, Bruton	1	0	0
Perkins, Col. E. K.	Shales, Bitterne, Hants	1	1	0
Petherick, R., jun.	Acland Barton, Landkey, Barn- staple	0	10	0
Petters (Ltd.)	Yeovil	1	0	0
Pettifer, T. & Co.	Eydon, Banbury	1	0	0
Phillips, F.	Nantcoch, Newport, Mon.	1	1	0
Phillips, G.	The Gaer, Newport, Mon.	1	0	0
Phillips, L. R. . . . .	. . . . .	1	1	0
Piggott, Brothers & Co. . . .	220, 222, 224, Bishopsgate Street, Without, London, E. C.	1	0	0

Name.	Residence.	Sub- scriptions.
		£ s. d.
Pike, C. A.	Chilean Nitrate Committee, Friar's House, 39-41, New Broad Street, London, E.C.2.	1 0 0
†Pinney, R. W. P.	Sutton Veny, Warminster	..
†Pitt, W.	South Stoke House, Bath	..
Plumptre, H. F.	Goodnestone, Dover	1 0 0
*Plymouth, Earl of	Hewell Grange, Bromagrove	4 0 0
Poole, Mrs. A. R.	King's Hill, Dursley	1 1 0
Pope, Alfred	Dorchester	1 0 0
Pope, John	Nowers, Wellington, Somerset	1 0 0
Popham, H. L.	Hunstrete House, Pensford, Bristol	1 0 0
Porter, W. J. H.	Glendale Farm, Wedmore	1 0 0
†Portman, Hon. C. B.	Goldicote, Stratford-on-Avon	..
Portman, Hon. Mrs. C. B.	Goldicote, Stratford-on-Avon	1 0 0
*Portman, Viscount	Bryanston, Blandford	5 0 0
Powell, G. E.	8, Osborne Road, Clifton, Bristol	1 0 0
Powell, G. F.	10, Beaufort West, Bath	1 0 0
Price, Owen	Nantyrharn, Cray, Brecon	1 0 0
Pritchard, H. L.	Penmaen, R.S.O., Glam.	1 0 0
Pritchard, D. F., J.P.	Crumlin Hall, Crumlin, Mon.	1 1 0
Proctor, H. and T. (Ltd.)	Cathay, Bristol	1 1 0
Proudfoot, W.	Woodbourne House, Shepton Mallet	1 0 0
Pullen, James	Lapdown Farm, Tormarton, Gloucester	1 0 0
†Purgold, A. D.	Ebna Lodge, Gobowen, Salop	..
Quantock Vale Cider Co.	North Petherton, Bridgwater	1 0 0
*†Radnor, Earl of	Longford Castle, Salisbury	..
†Ransome, B. C.	Orwell Works, Ipswich	..
Rawlence, Ernest A.	Newlands, Salisbury	1 0 0
Rawlence, Capt. G. Norman	Salisbury	1 0 0
Read, B.	Church Farm, Cam, Dursley, Gloucester	1 0 0
Reeves, Robert and John, and Son	Bratton Iron Works, Westbury, Wilts	1 0 0
Remnant J. F., M.P.	The Grange, Hare Hatch, Twyford	1 0 0
Richardson, Rev. A.	Bath and County Club, Bath	0 10 0
Riley, J. L. & A.	The Iwerne, near Ledbury	1 0 0
Robins, J.	High Bray, South Molton	1 0 0
Robins, W. & H. V.	Gratton Barton, High Bray, South Molton	1 0 0

Name.	Residence.	Sub- scriptions.		
		£	s.	d.
Robinson, E. S. & A. (Ltd.)	Redcliffe Street, Bristol . . .	1	1	0
Robinson, John & Co. . .	Bristol	1	1	0
Roe, W. J.	West Pennard, Glastonbury . . .	1	0	0
Rogers, E. P.	Tregye, Perranwell, Cornwall . .	1	0	0
Rolleston, S. V.	Saltford House, Saltford, Bristol .	1	0	0
Rolleston, Col. V., J. P. . .	Saltford House, near Bristol . . .	1	1	0
Roundway, Lord	Roundway Park, Devizes	1	0	0
Rouse-Boughton, Sir W. . .				
St. A., Bart.	Downton Hall, Ludlow	1	0	0
Rouse-Boughton, Lady . . .	Downton Hall, Ludlow	1	0	0
Rowlands, P. S.	The Laurels, Stangennith, Reynold- ston, S.O., Glam.	1	1	0
Rowliffe, E. L.	Hall Place, Cranleigh, Guildford .	1	1	0
Royal Guernsey Agricul- tural and Horticultural Society	Guernsey	1	0	0
Ruston, Proctor & Co. (Ltd.)	Lincoln	1	0	0
Rutherford, J. A.	Highclere Estate Office, Newbury, Berks	1	0	0
Saillard, P.	Buchan Hill, Crawley, Sussex . .	1	0	0
†St. Germans, Earl of . . .	St. Germans, Cornwall	2	0	0
†Salmon, H. C.	North Field, Bridgwater . . . . .	..	
Salter, Benjamin	Newlands, Broadclyst, Exeter . .	1	0	0
Salter, T.	Beare Farm, Broadclyst, Exeter . .	1	0	0
Samuelson, Ernest	Bodicote Grange, Banbury	1	1	0
Sanders, Lt.-Col., R. A., M.P.	Barwick House, Yeovil	1	0	0
Sandys, Capt. G. J.	Hatherleigh House, Weston-super- Mare	1	1	0
Sanford, Col. E. C. A., C.M.G.	Nynehead Court, Wellington, Somt.	1	0	0
Sanford, H. S. J. A.	The Court House, Middlehill, Broadway, Worcestershire	1	0	0
Sankey, R. I.	Queen Anne Mansions, St. James's Park, London, S.W.	1	0	0
†Scott, T. . . . .		..
†Seaton, Lord	Beechwood, Plympton, Devon . . .	..	
Senior and Godwin	Auctioneers, Sturminster Newton, Dorset	1	1	0
†Shaw-Stewart, Walter R. . .	Hayes, Shaftesbury . . . . .	..	
*Shelley, Sir John, Bart. . .	Shobrooke Park, Crediton	2	2	0
Shelley, Capt. J. F.	Posbury House, near Crediton . .	1	0	0
Sheppard, P. C. O.	Dunraven Estate Office, Bridgend, Glam.	1	1	0
†Sherston, C. J. T.	Harewood, Leeds . . . . .	..	
*Sidmouth, Viscount	Upottery Manor, Honiton	2	0	0
Sillifant, A. O.	Culm Leigh, Stoke Canon, Exeter .	1	0	0

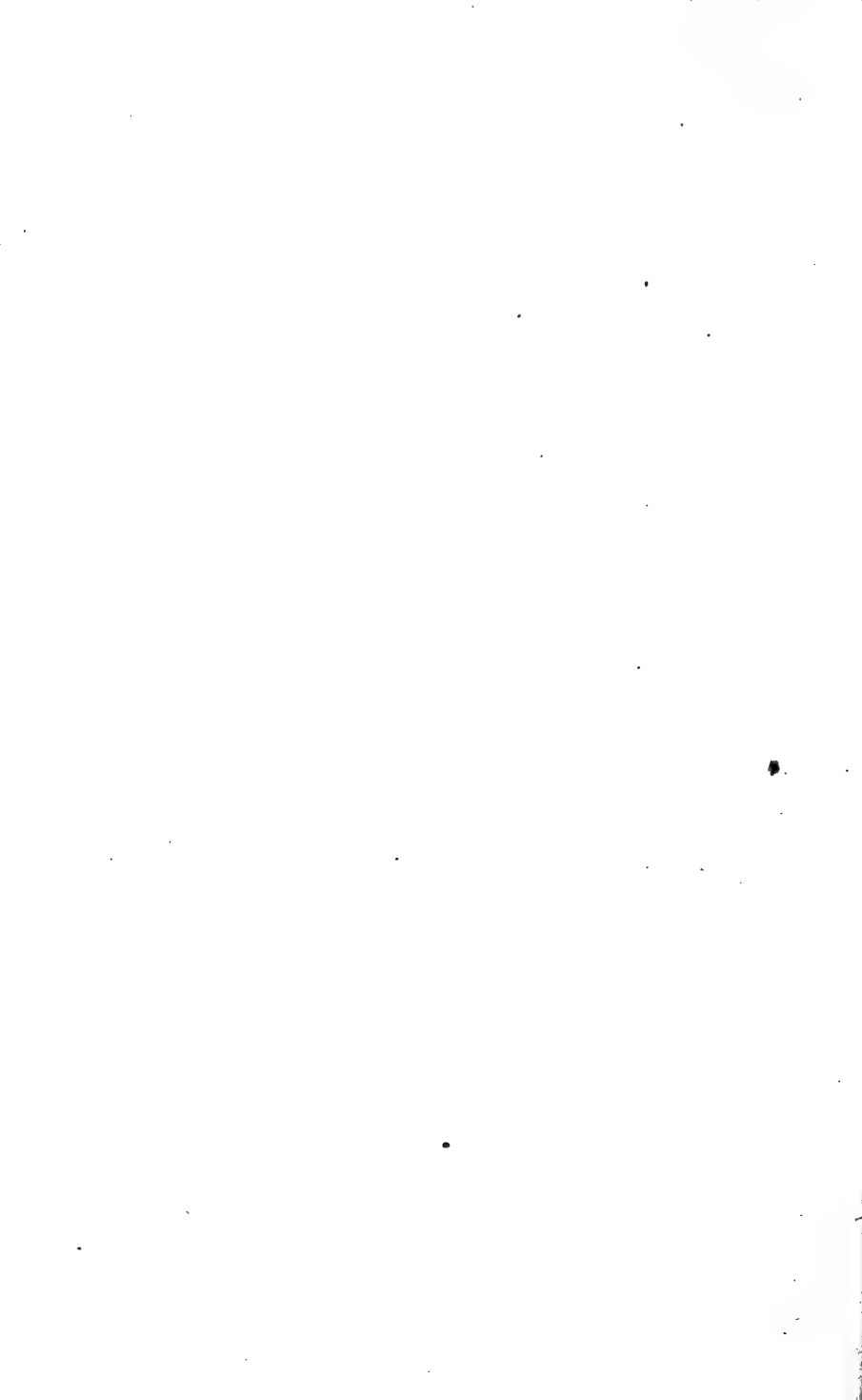
Name.	Residence.	Subscriptions.		
		£	s.	d.
*Simpson, Charles (Hewthorn & Co.)	Walton Lodge, Broxbourne, Herts.	2	0	0
Simpson, F. C.	Maypool, Churston Ferrers, R.S.O., S. Devon	1	0	0
*Singer, W. M. G.	42, Charles Street, Berkeley Square, London, W.1	2	0	0
Skinner, G. C.	Pound, Bishops Lydeard	1	0	0
Skyrme, J. H.	Madley, Hereford	1	0	0
Slatter, J.	Paxford, Campden, S.O., Glos.	1	0	0
Smart, G. E.	Combe Hay Manor, Bath	1	1	0
Smith, A. J.	Brooklea, St. Anne's Park, Bristol	1	0	0
Smith, C. C. F.	Perfect Dairy Machines (Ltd.), 105, Middle Abbey Street, Dublin	1	0	0
Smith, J.	Monkton, Hereford	1	0	0
†Smith, J. W.	Thinghill Court, Hereford	..	..	..
Smith, Hon. Mrs. Murray	Gumley Hall, Market Harborough	1	0	0
†Smith, S. Lee	Larkfield, Maidstone	..	..	..
Smyth, Hon. G. N.	Ashton Court, Bristol	1	0	0
Smyth, P.	Broford, Dulverton	1	0	0
Smyth-Richards, G. C.	Filleigh Lodge, South Molton	1	0	0
*Somerset, Duke of	Maiden Bradley, Bath	2	0	0
Somerset Trading Co. (Ltd.)	Bridgwater	1	1	0
†Somerville, A. F.	Dinder House, Wells, Somerset	..	..	..
Southwood, J. W.	1, St. Peter's Terrace, Twerton, Bath	1	0	0
Spear Brothers and Clark (Ltd.)	Southgate Street, Bath	1	0	0
†Spearman, Sir J. L. E., Bart.		..	..	..
Spencer, F.	Pondsmead, Oakhill, Bath	1	1	0
Spencer, W. C.	Manor Farm, Hillfield, Cattistock, Dorset	1	0	0
Spicer, Capt.	Spye Park, Chippenham	1	0	0
Spicer, Lady M.	Spye Park, Chippenham	1	0	0
Spillers and Bakers (Ltd.)	Cardiff	1	1	0
Spratts' Patent (Ltd.)	24 and 25, Fenchurch Street, City, London, E.C.3	1	0	0
*†Stanley, E. A. V.		..	..	..
Stevens, R. N.	Woodham Hall, Woking, Surrey	1	0	0
Stewart, Rev. H. J.	The Vicarage, Cockett, Glam.	1	0	0
Stilgoe H. W.	The Grounds, Adderbury, near Banbury, Oxon	1	0	0
Stoddart, F.	Manor House, Walton, Clevedon	1	1	0
Stoffell, W. M.	Fairfield, Newbridge Hill, Bath	1	1	0
Storarr, J. I.	Hamilton Estate Office, The Palace, Hamilton	1	0	0
Stothert, Sir P. K.	Bradford-on-Avon, Wilts	1	0	0
†Strachie, Lord	Sutton Court, Pensford, Somerset	..	..	..
Strafford, Earl of	Dancers Hill, Barnet	1	0	0
Strangways, Hon. H. B. T.	Shapwick, Bridgwater	1	0	0

Name.	Residence.	Subscriptions.		
		£	s.	d.
Stratton, Richard	The Duffryn, Newport, Mon. . . .	1	0	0
Stride, T.	Stanley House, Camden Road, Bath	1	0	0
Strode, G. S. S.	Newnham Park, Plympton	1	0	0
Stucley, H. V. G.	Pillhead, Bideford, North Devon	1	0	0
Studdy, T. E.	Mazonet, Stoke Gabriel, Totnes	1	0	0
Studley, J. Im.	Toller Fratrurn, Maiden Newton	1	0	0
*Sutton, E. P. F.	Sidmouth Grange, near Reading	2	2	0
*Sutton and Sons	Seedsmen, Reading	2	2	0
Swansea, Lord	Singleton, Swansea	1	1	0
Swanwick, Bruce	R. A. College Farm, Cirencester	1	0	0
Symons J. & Co. (Ltd.)	The Plains, Totnes	1	1	0
Tangyes (Ltd.)	Cornwall Works, Birmingham	1	0	0
Tapp, David James	Knaplock, Winsford, Dulverton	1	0	0
Tasker W. & Sons (Ltd.)	Waterloo Ironworks, Andover	1	1	0
Tate, J. A.	Fairfield, Wells, Somerset	1	0	0
Tatem, W. J.	The Court, St. Fagan's, Glam. . . .	1	0	0
Taverner, G. E.	Budlake, Devon	1	0	0
Taylor, A. H. W.	8, New Bond Street, Bath	1	0	0
†Taylor, George	Cranford, Hounslow, W. . . .	..	..	..
Taylor, H. W.	Showle Court, Ledbury, Hereford	1	0	0
†Tazewell, W. H.	Manor House, Taunton . . . .	..	..	..
*Temple, Earl	Newton St. Loe, Bristol	2	2	0
Templeman, G. D.	Hambridge, Curry Rivell, Taunton	1	0	0
Thomas, Sir Griffith	Court Herbert, Neath	1	0	0
Thomas, I.	Ely Farm, Cardiff	1	0	0
Thomas, J.	Velindre, Kidwelly, Carmarthen-shire	1	1	0
Thomas-Stanford, C., M.P.	Preston Manor, Brighton	1	0	0
Thomas & Evans & John Dyer (Ltd.)	Swansea	1	0	0
Thompson, C. E.	Camerton, Bath	1	1	0
Thorley, J.	Wood Hall, Shenley, Herts	1	0	0
Thorne, J. G.	Horridge, Romansleigh, S. Molton. . . .	0	10	0
Thornton, W. A.	Lock, Partridge Green, Sussex	1	0	0
Thresher, E. B.	Corfe Hill, Weymouth	1	0	0
Thurlow, G. R.	Stowmarket	1	0	0
Tidswell, R. J.	Haresfield Court, Stonehouse, Glos. . . .	1	0	0
Tillard, Rear-Admiral P. F.	Alford House, Castle Cary	1	0	0
Timmins, T. B.	24, Green Park, Bath	1	0	0
Tipper, B. C., and Son	Balsall Heath, Birmingham	1	0	0
Titt, J. W.	Implement Works, Warminster	1	0	0
Toogood, E. K.	Messrs. Toogood & Sons, Southampton	1	0	0
Trafford, G. R.	Hill Court, Ross, Herefordshire	1	1	0
*Tredegar, Viscount	Tredegar Park, Newport, Mon. . . .	2	2	0

Name.	Residence.	Subscriptions.
		£ s. d.
Treffry, I. de C.	Penarwyn, Par Station	1 1 0
Trelawney, J. S.	Harewood, Buckfastleigh, Devon	1 0 0
†Tremaine, W. H.	Sherborne, Northleach, Glos.	..
Tremayne, Col. W. F.	Carclews, Perran ar Worthal, Truro	1 1 0
Treowan, Lord	Llanarth Court, Raglan, Mon.	1 0 0
Troup, Alan C.	Doddean, Salisbury	1 0 0
Troyte, H. A.	Huntsham Court, Bampton, Devon	1 0 0
Troyte, Major H. A.	Slington, Arundel, Sussex	1 0 0
Trump, W.	Borough Farm, Broadclyst, Exeter	1 0 0
Tucker, H.	Sutton Montis, Sparkford, Bath	1 0 0
Tucker, M. & Co.	Broad Quay, Bath	1 0 0
†Tudway, C. C.	The Cedars, Wells, Somerset	..
Turnor, Lt.-Col. W. W.	Pinkney Park, Chippenham	1 0 0
Unite, John (Ltd.)	291, Edgware Road, London, W.2	1 0 0
†Vacher, E. P.	Cowfold Lodge, Cowfold, Sussex	..
Vaughan, Rev. Preb.	The Rectory, Wraxall, Somerset	1 0 0
Vaughan, W. I.	9, Queen's Place, Cardiff	1 0 0
Veitch, P.	Exeter	1 0 0
†Verulam, Earl of	Gorhambury, St. Albans	..
Vine & Co. (Ltd.)	Cornhill Chambers, Swansea.	1 1 0
Vivian, Miss	Clyne, Blackpyl, S. Wales	1 1 0
Waide, W. and Sons	Churn Works, Leeds	1 0 0
Wainwright, C. Donald	Summerleaze, Shepton Mallet	1 1 0
Waldegrave, Earl	Chewton Priory, Somerset	1 0 0
*Waleran, Lord	44, Hans Mansions, London, S.W.	2 0 0
Walker, E. G. F.	The Hollies, Chew Stoke, Bristol	0 10 0
Walker, H.	Beach, Bitton, Glos.	1 0 0
Wallis and Stevens	North Hants Iron Works, Basingstoke	1 0 0
Wallop, Hon. J.	Barton House, Morchard Bishop, Devon	1 0 0
Walrond, Hon. Mrs. C. M. L.	Bradfield, Cullompton	1 1 0
†Walsingham, Lord	Merton Hall, Thetford, Norfolk	..
Ward, J. E.	Red Lodge, Purton, Wilts	1 0 0
Ward, R. B.	Westwood Park, Droitwich	1 0 0
Wardlaw, H. and A.	Holway Farm, Sherborne	1 0 0
†Waring, C. E.	Conservative Club, Cardiff	..

Name.	Residence.	Subscriptions.		
		£	s.	d.
Waring, H. F.	Farningham Hill, Farningham, Kent	1	0	0
†Warner, T. C.	Bretterham Park, Suffolk		
Waterloo Mills Cake and Warehousing Co. (Ltd.) .	Wilmington, Hull	1	0	0
Watson, H. R.	Purse Caundle, Sherborne	1	0	0
Watson, T. E.	St. Mary's Lodge, Newport, Mon. .	1	0	0
Watson, Capt. Hon. T. H. .	Cormiston, Milverton, Somerset .	1	0	0
Watts, J.	Backwell, near Bristol	1	0	0
*Way, General N. S. . . .	Manor House, Henbury, Bristol . .	2	0	0
Weaver & Co.	Beaufort Warehouses, Swansea . .	1	0	0
Webb, E. and Sons	Wordsley, Stourbridge	1	0	0
Webb H. C.	Llwynarthen, Cardiff	1	0	0
Welch-Thornton, H. . . .	Beaurepaire, Basingstoke	1	1	0
Wernher, Lady	Luton Hoo, Luton	1	1	0
Wessex Associated News (Ltd.)	Westgate Street, Bath	1	0	0
Westminster, Duke of . .	Eaton Hall, Chester	1	1	0
Weston, H. and Sons . . .	The Bounds, Much Marcle, <i>via</i> Dymock, Herefordshire	1	0	0
†White, A. R.	Charnage, Mere, Wilts		
White, F.	Torweston, Williton	1	0	0
White, W. J. S.	Zeals Park, Wiltshire	1	0	0
Whitley, S. R.	Rookwood, Shinfield, Reading . .	1	0	0
Whitley, W. and H. . . .	Primley Farm, Paignton	1	0	0
Whitting, C. E.	Uphill Grange, Weston-super-Mare	1	1	0
Wilder, J.	Yield Hall Foundry, Reading . . .	1	1	0
Willeox, W. H. & Co. . . .	36, Southwark Street, London, S.E.1	1	0	0
Williams, G. L.	Chavenage, Tetbury	1	1	0
Williams, Major Jestyn . .	Kilfoye, Holme Lacy, Hereford . .	1	0	0
Williams, J.	Scorrier House, Scorrier, Cornwall .	1	0	0
Williams, J. C., M.P. . . .	Werrington Park, Launceston . . .	1	0	0
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HIGHWORTH HERD DAIRY SHORTHORNS. Bull Calves on sale, excellently bred for milk. Stock Bulls: Primrose Duke of Dreadnought, dam Primrose 3rd, dam of Elsie Foggathorpe; Kelmscot Freemason by Cranford Freemason, dam Lovely 69th, both stock bulls 1,000-gallon dams each side. A. F. Chillingworth & Sons, Queenslains Farm, Highworth, Wilts.

HOBBS, C. H., OLDPORT, OSWESTRY. Dual-purpose Shorthorns, good families, bulls for sale. Station one mile.

HOLMAN, MICHAEL H., RESTRONQUET, PENRYN. Shorthorns: Trethewey Ruths, Hosken Carnations, Brilliants, Butterfly, Cowslip, Roan Kitty. Scotch include Graceful, Marigold, Rosemary, Jealousy, Ury Maid, Lady J., and Broadhooks. Stock Bulls: Royal Benedict, Fairlawne Prince Regent, M. H. H., Umpire, and Restronguet Lord John.

BREEDERS' DIRECTORY.

CATTLE—continued.

KIRK, THOMAS, ABBEY MAINS, HADDINGTON, EAST LOTHIAN. Shorthorn Cattle. Many of the best Cruickshank families are represented in this Herd, viz.: Broadhooks, Princess Royals, Nonpareils, Butterflies, Goldies, Duchess, Clippers, Bessies, etc.

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LISTER, MAJOR JOHN J., WARNINGLID GRANGE, HAYWARDS HEATH, SUSSEX. Railway Station: Haywards Heath. Telegraphic address: Warninglid. Telephone Warninglid 5. Strict milk records of all cows kept.

MARDEN PARK SHORTHORNS. London, 17 miles. The Property of Sir Walpole Greenwell, Bart.: Stock Bulls, Edmond 111713 and Marden Dane 5th, Vol. 62. This fine herd of Shorthorns, with great adaptability for producing flesh, has been very successful in the showyards, including Royal Show at Manchester, 1916. Bulls and Heifers of the choicest breeding always on sale. Particulars from J. W. Morgan, Estate Office, Marden Park, Woldingham, Surrey, who will be pleased to show the Herd by appointment. Telegrams, Morgan, Woldingham.

MORRIS, CHARLES, HIGHFIELD HALL, ST. ALBANS. Most successful at leading shows, 12 champion and over 50 first prizes in recent years. Selections from this herd have been exported to Australia, New Zealand, East and South Africa, Argentine, India Brazil, and the Continent; 150 to select from. St. Albans half an hour by train from London. Inspection by appointment. Illustrated catalogue on application.

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CATTLE—continued.

(Garnes) families. Stock Bulls: Count Crystal 168276, Edgcote Regalia 125396, Chief Mint, and Fairlawne Air Raid. Inspection invited. Telegrams and Railway Station: Dungiven, quarter mile. Apply Estate Office, Pellipar, Dungiven, co. Londonderry.

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SHORTHORN CALVES for rearing from best Carmarthenshire Dairy Herds always for sale. James, Cilwngw Farm, Llanelly.

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WELBECK HERD OF PEDIGREE SHORTHORNS, the property of the Duke of

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CATTLE—continued.

Portland. Young Bulls and Heifers for sale from the best strains. Apply, Alex. Galbraith, Norton, Cuckney, Mansfield.

WINKHURST HERD, the property of A. H. L. Bohrmann, Esq., Winkhurst Green, Ide Hill, Sevenoaks, Kent. Pedigree Shorthorns, dual-purpose type, long pedigrees only. Nearest Station: Penshurst $2\frac{1}{2}$ miles.

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ANTHONY SOUTH DEVON HERD, the property of Lieut.-General Sir Reginald Pole-Carew, K.C.B. Pedigree herd of deep milking cattle, including cows of over 1,000 gallons. Daily milk records kept. Bulls, Cows, and Heifers for inspection and sale. Apply W. H. Hill, Antony Estate Office, Torpoint S.O., Cornwall.

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NEWELL, RICHARD, BACHELLYN, PWLLHELI. Pedigree Welsh Black Cattle from best prize-winning

CATTLE—continued.

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SHEEP.

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SHEEP—continued.

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HOBBS, C. H., OLDPORT, OSWESTRY. Ryeland Flock, No. 11. Ewes and Rams for sale.

RYELAND SHEEP, the coming breed; Clytha Park Flock, winners of many prizes in previous years, including four first prizes Herefordshire and Worcestershire Show, 1916, and two first prizes, four second prizes, and one for wool at Royal Show, Manchester, 1916; winners of first prize best pen five Ewes at Hereford Ryeland Show and Sale, August 1918. Shearling Rams and Ram Lambs, etc., for sale. Apply, Manager, Clytha Park, Abergavenny.

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SHEEP—continued.

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PIGS.

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PIGS—*continued.*

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PIGS—*continued.*

ter, or personally to Manager of Piggery, at Worsley, near Manchester.

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Both these horses are in G.S.B. and Arab H. Stud Book therefore belonging to the five great families of desert horses, of which few remain.

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